Volume 80 Number 11

POWER

MASON BRITTON, *Senior Vice-president* · PHILLIP SWAIN, *Editor* · N. O. WYNKOOP, *Manager*

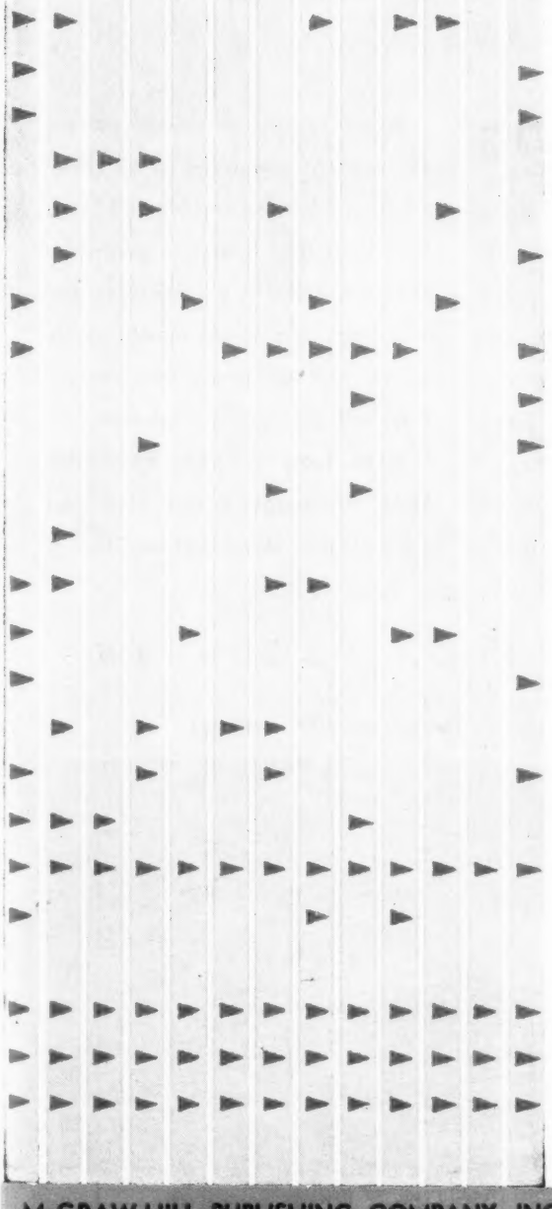
Associate Editors—F. A. ANNETT, R. B. PURDY, E. J. TANGERMAN

Washington
PAUL WOOTON

NOVEMBER, 1936

POWER TOPICS CROSS-INDEX

STEAM GENERATION · POWER GENERATION · WATER POWER · DIESEL & GAS ENGINES · AIR CONDITIONING & HEATING · REFRIGERATION · PUMPS & COMPRESSORS · STEAM SERVICES · ELECTRICITY & ELEVATORS · INSTRUMENTS & CONTROL · PIPING SYSTEMS · MECHANICAL TRANSMISSION · POWER MISCELLANY



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McGRAW-HILL PUBLISHING COMPANY, INC.

Publication Office, 99-129 North Broadway, Albany, N. Y.
Editorial and Executive Offices: 330 West 42nd St., New York, N. Y.

JAMES H. McGRAW, JR. Chairman · MALCOLM MUIR President · JAMES H. McGRAW Honorary Chairman
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BOSTON, 1427 Statler Bldg.
ATLANTA, 1105 Rhodes Haverty Bldg.
LONDON, Aldwych House, Aldwych, London, W.C.2

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POWER articles are currently indexed in both the Industrial Arts and the Engineering Indexes, available at public libraries. Also every year POWER issues an annual index of its own. Cable Address: "McGraw-Hill, N. Y."

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for corrosive process piping

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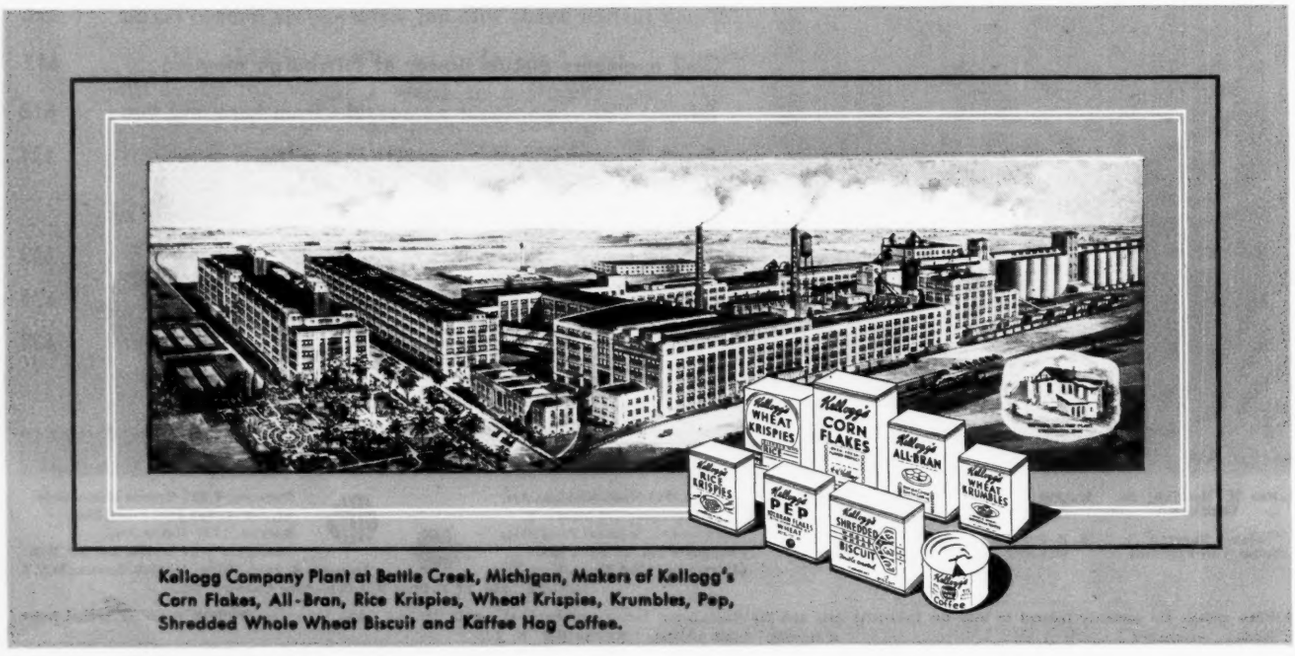


Kellogg Company Plant at Battle Creek, Michigan, Makers of Kellogg's Corn Flakes, All-Bran, Rice Krispies, Wheat Krispies, Krumbles, Pep, Shredded Whole Wheat Biscuit and Kaffee Hag Coffee.

POWER

A McGRAW-HILL PUBLICATION. EST. 1882

PHILIP W. SWAIN

Editor

Average Plant – Big Job

GREAT superstations catch the public eye, but "average" plants employ most of the power engineers, burn most of the power coal, generate the bulk of the nation's steam, offer the greatest opportunities for dollar savings.

To get a mental picture of this potent average plant, consider first the entire power field—utility, industrial, mine, building and institutional. At the top are all of the "big" plants with more than 50,000 sq.ft. of boiler heating surface or 5,000 hp. of prime movers. At the bottom eliminate the tens of thousands of miniature power outfits, too small for a real engineer, having neither 2,000 sq.ft. in boiler surface nor 200 hp. of any kind of prime movers. Between these limits lie the major power-generating expenditures of the nation and the major opportunity to save power dollars. Service to this rich field, exemplified by ten plants described in this number, is a primary objective of *Power's* editorial service.

This average plant must be sized up individually as well as collectively By what yardstick shall we judge its importance? Certainly not by kilowatt capacity. Nothing but confusion results from the attempt to transplant this capacity measure from the central stations, where it fits, to the industrials, where it doesn't. The kilowatt is only an incidental part of the industrial power-service output—a part that bears not even an approximately fixed relationship to the whole.

The industrial power engineer's job is to generate and transmit all of the power services: steam, hot water, cold water, mechanical horsepower, kilowatts, compressed air, refrigeration, heating, ventilating, conditioned air. Nationally considered, it is doubtful if kilowatt generation involves more than 20% of the total cost of power-service generation in industrials, institutions and buildings. If their every kilowatt-producing prime mover were destroyed, 80% of the existing industrial power equipment would be needed to produce the other required services.

Kilowatts, as we have shown, are meaningless as an industrial-power yardstick. Steam-generating capacity is fairly dependable, although not perfect. Dollars alone are the perfect measure, applicable to all plants, including central stations—dollars invested, dollars spent in yearly operation, dollars to be saved by shifting from Topsy-grown to economic operation.

The real point we are trying to get over is the financial importance of expert management of the average industrial power plant. The quickest way we know to pick up some easy profits in the typical factory, institution or large building, is to hire a first-class engineer, pay him an adequate salary, give him ample authority to make improvements, then hold him responsible for the dollar results.

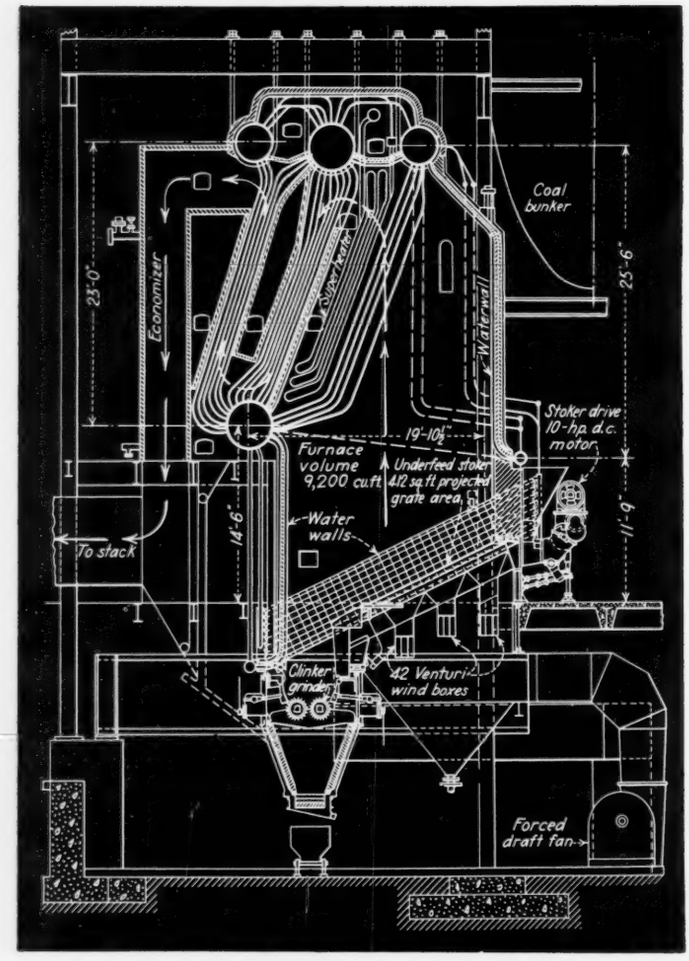


Fig. 1—Boiler has 15,147 sq. ft., water-walls 1,800, economizer 8,247, and the superheater 5,440 sq. ft. of heating surface

A 900-LB. TOP

. . . comprising a stoker-fired boiler supplying 180,000 lb. of steam per hr. at 900 lb. and 750 deg. F. to a 6,250-kw. turbine bled at 400 and exhausting at 140 lb. These feature a modernization program of the Pittsburgh Plate Glass Co., Columbia Chemical Division

A FEW years ago, if an industrial process required 150-lb. steam, there was nothing to do but install 150-lb. boilers to supply the demand. Development of high-pressure boilers has changed all this, and now, not only 150-lb., but 400-lb., steam may be extracted from a steam-turbine generating unit operating on higher-pressure steam. By doing this, steam and power loads are supplied at minimum cost. A good example of how progressive plant managers are taking advantage of economic possibilities of high pressures is found in the new power installation of the Columbia Chemical Division of the Pittsburgh Plate Glass Co., Barberton, Ohio.

This plant requires large quantities of process steam, which was originally supplied by exhaust from engine drives on pumps and compressors. The balance between power and steam required was obtained by generating power with condensing turbo-generators, one of which was of the extraction type.

Increased demands for power and process steam required that a modernization program be started in 1935. New processes required higher pressures and temperatures. A large saving could also be made by installing high-pressure boilers so that more power could be generated at pressures above process requirements and in this way eliminate turbines operating condensing. The first unit of this new installation went into service in July of this year.

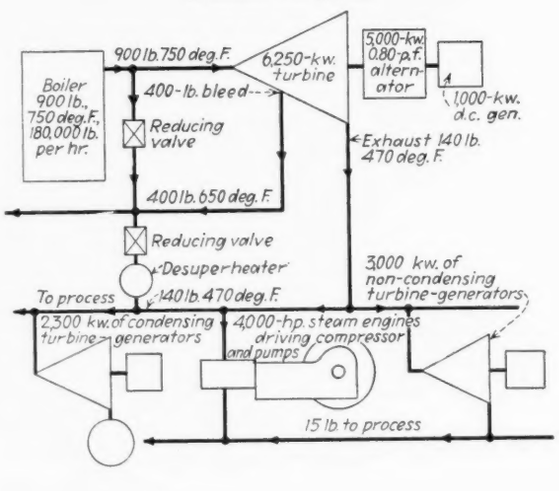
A Stirling-type boiler, Fig. 1, with fusion-welded drums and a continuous rating of 180,000 lb. of steam per hr. at a pressure of 900 lb. per sq.in. and 750 deg. F. total temperature was selected. This boiler is installed in an extension to the present boiler plant.

A pressure of 900 lb. was selected because it was the highest pressure at which boilers have been operated using a high percentage of treated make-up water. Practically all feedwater for this boiler is makeup, there being only a small amount of condensate return from process. A temperature of 750 deg. was chosen because it was the highest temperature that could be used and not have turbine-exhaust temperature exceed that in the 140-lb. header.

A steam scrubber is provided in the boiler. When supplying 140,000 lb. of steam per hr., and operating with boiler water containing 2,000 to 3,000 parts of solids per million, the scrubber delivers steam to the superheater header having less than 0.1 per cent moisture.

A 3-loop, continuous-tube superheater gives 750 deg. F. total steam temperature at 125,000 lb. capacity. An economizer of the continuous-tube type arranged in five sections with 8,247 sq.ft. of heating surface was selected. Acid method of cleaning economizer tubes of this type on some of the low-pressure boilers has proved satisfactory. For this reason and also because on the new boiler it was also desirable

Fig. 2—The plant uses four steam pressures for power generation and process


Boiler 900 lb., 750 deg.F., 180,000 lb. per hr.
900 lb. 750 deg. F.
6,250-kw. turbine
400-lb. bleed
Reducing valve
5,000-kw. 0.80-p.f. alternator
1,000-kw. d.c. gen.
Exhaust 140 lb. 470 deg. F.
400 lb. 650 deg. F.
Reducing valve
Desuperheater
To process
140 lb. 470 deg. F.
3,000 kw. of non-condensing turbine-generators
2,300 kw. of condensing turbine-generators
4,000-hp. steam engines driving compressor and pumps
15 lb. to process

to keep the number of joints to a minimum, a continuous-tube economizer was selected.

From an economic standpoint either a large economizer or a large air heater could have been justified, but because of operating conditions, the decision was made in favor of the economizer. Feedwater connections are so arranged that the economizer may be bypassed and water delivered directly to the boiler at heater temperature. When the boiler is operating this way, gas at a temperature around 700 deg. will pass through the economizer, it being designed to stand this without injury.

Boiler Stoker Fired

The boiler is stoker-fired in a high furnace setting, the mud drum being 14 ft. 6 in. above the firing floor, Figs. 1 and 5. Front and rear walls of the furnace are water cooled. The front wall, with 990 sq.ft. of cooling surface, is of bare-tube tile construction. In the rear wall there are 170 sq.ft. of Bailey blocks in the bottom section, with 500 sq.ft. of bare-tube and tile construction above. To insure ample protection for the side walls along the stoker fuel-bed zone, inclined waterwalls nine tubes high, containing 70 sq.ft. of block surface, are provided. Refractory side walls above the water-cooled sections are of sectionally-supported air-cooled construction.

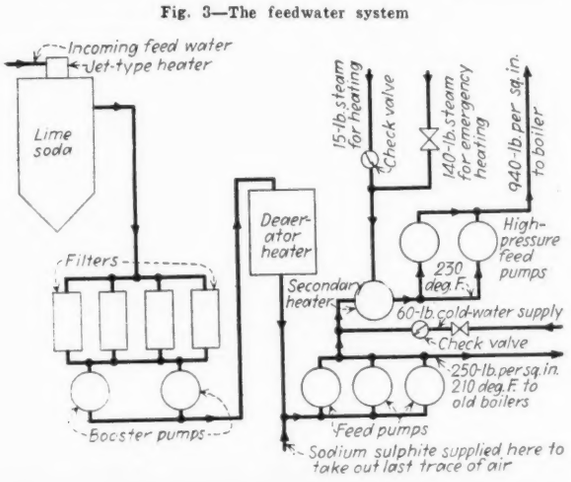
In 1926, three of the boilers were fired by an early design, dump-type, multiple-retort underfeed stoker. The coal-purchase situation was then such as to make it desirable to burn a wide variety of coals, several of which being a low-fusing-ash class. One of them that seemed particularly desirable on a B.t.u. basis was Belmont-County slack. An exhaustive study, including combustion efficiency, reliability, operating cost and steam cost, was made by the company's engineers in cooperation with Charles W. E. Clarke, consulting engineer.

As a result of this work it was decided that a multiple-retort, rotary ash-discharge stoker of modern design would be the most economical, provided Belmont-County slack could be successfully burned on it. An old stoker was replaced by one of modern design, including air-cooled and water-cooled furnace walls. Twenty-four-hour tests were conducted on five successive days. A combined boiler and furnace efficiency of 83.2 per cent, with low excess air, was obtained at 187 per cent boiler rating. The coal used in this test had a heat content of 12,120 B.t.u. and carried 12.35 per cent ash, of which 25.6 per cent was ferrous oxide, giving the ash a fusing temperature of less than 2,100 deg. F.

These tests led to the installation of larger stokers of the same design on three new 15,440-sq.ft. boilers, and were a major factor in the decision to use a stoker under the new high-pressure boiler. This stoker has 13 retorts, 41 tuyeres, with a projected grate area of 412 sq.ft., and is d.-c. motor-driven. At maximum continuous boiler rating, it burns 50 lb. of coal per sq.ft. of grate area per hr. When burning a No. 8 Ohio coal, a monthly over-all furnace and boiler efficiency of about 85 per cent is obtained with daily efficiencies as high as 87 per cent.

Combustion air to the stoker is controlled through 42 venturi windboxes. These are arranged in three rows of 14 boxes each across the rear, front and middle zones of the stoker. Each box is provided with a damper to control air flow and the 42 boxes connect to three 14-point draft gages on the boiler panel.

Fig. 3—The feedwater system



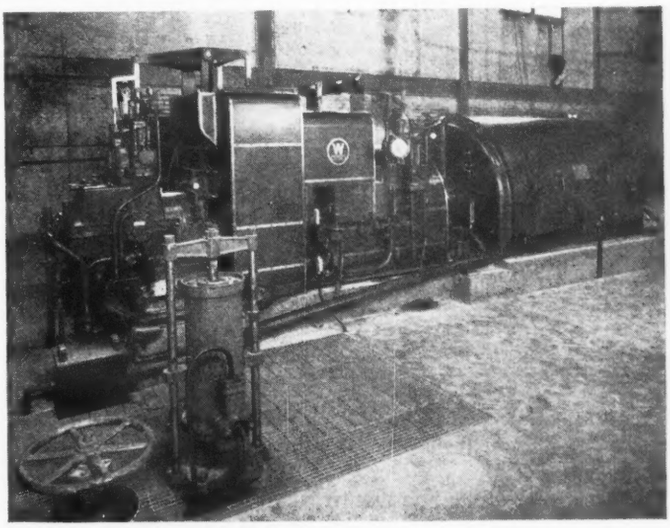


Fig. 4—Operating on 900-lb. steam, this 6,250-kw. turbine is bled at 400 lb. and exhausts at 140 lb.

At the present time, it is necessary to enter the windbox to modify the amounts of air discharged through the upper, intermediate and lower sections of the stoker. An air lock is provided for entrance to the windbox. As a result of the experience to date, a method of controlling air flow to various sections of the stoker by operation from the control board will be provided in the near future.

Turbine Drives

All auxiliaries, feed pumps, forced-draft and induced-draft fans are turbine-driven. Turbines were selected because of their flexibility of control, and when the present modernizing program is completed the entire plant will be operating non-condensing, all exhaust going to process. Feed-pump speed is controlled automatically by the drum water-level recorder acting on the regulating valve of the turbine. Because of the close turbine-speed control and a single boiler, a pressure differential of only 30 to 40 lb. is maintained over steam pressure, resulting in a considerable reduction in power compared to a differential of 100 to 200 lb. used in some plants.

The automatic system of combustion control regulates stoker and induced-draft fan speed from a master regulator, according to steam demand, as indicated by header pressure. Constant pressure is maintained in the furnace by a regulator controlling forced-draft fan speed. This control system will

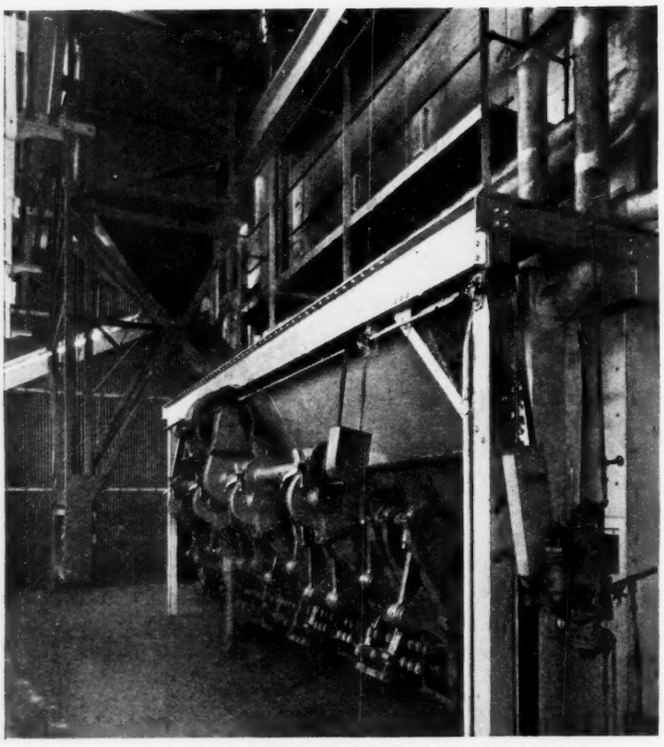


Fig. 5—The boiler is fired by an underfeed stoker with a 42-zone air-control system

automatically maintain efficient combustion and practically constant steam pressure over a steaming range of 50,000 to 180,000 lb. per hr.

The welded steam header is 350 ft. long, from the superheater outlet to the quick-closing valve on the turbine. The non-return valve is welded to the superheater outlet; steam-flow meter orifices and division valves are also welded into the header. This line has given complete satisfaction.

V-type butt welds with a chill ring inside the pipe are used. Exhaustive tests were made on sample welds before actual welding. On a cold-bend test, samples were bent until the outside of the bend elongated 50 per cent, without showing any signs of failure, compared to insurance company requirements of only 30 per cent elongation. To make tensile-strength tests of the welds it was necessary to reduce the weld cross-section in the test pieces below that of the parent metal to get failure in the weld. Failure in the weld occurred at about 57,000 lb. per sq.in. compared to 55,000 in the pipe metal.

Since the boiler operates with feedwater that is over 80 per cent makeup, very careful attention is given to its treatment. Raw water is first treated with lime soda to precipitate out the solids and is then filtered. From the filters it is delivered to a deaerating heater by a booster pump. This heater connects to the suction header of the feed pumps for the old boilers, Fig. 3. Sodium sulphite is added to this header to remove the last trace of air. A phosphate treatment is added to the water in the boiler mud drum and a continuous blowdown of about 5 to 6 per cent maintained.

Feed pumps discharge to the old feedwater header at 250 lb. pressure. From the header, feedwater goes through a secondary heater to the suction of the high-pressure boiler-feed pumps. This heater is designed for 140 lb. pressure, but normally uses 15-lb. steam to heat the water to about 230 deg. F., at which temperature the feed pump delivers it to the economizer. By using 140-lb. steam in the feedwater heater and raising feedwater temperature to 325 deg., output of the boiler can be increased about 10 per cent, but with about 2 per cent drop in efficiency. This is done only when demand for high-pressure steam exceeds the maximum continuous rating of the boiler.

An emergency 60-lb. cold-water supply line connects into the feedwater line between the 250-lb. header and the secondary heater. Should the normal source of feedwater fail, cold water would be automatically admitted to the secondary heater and to the feed pumps through a check valve. Tests have shown that the boiler may be safely operated in this way until other provisions can be made to carry the load.

Control of the boiler is centered on a meter and control panel, Fig. 6. In addition to the automatic-combustion-control master and the three 14-point draft gages already mentioned, a 5-point draft gage connects to the furnace, windbox, boiler outlet, economizer outlet, and forced-draft-fan inlet, which connects to the air passages in the furnace walls. A boiler meter records steam flow and air flow and the water level in the boiler drum and controls the feed-pump turbine-regulating valve. A selector valve permits operating either of the boiler-feed pumps from the water-level recorder.

A 7-point graphic meter records temperature of the feedwater entering and leaving the deaerating heater, water leaving the economizer, steam leaving the superheater, flue gas leaving the boiler, flue gas leaving the economizer and air at the forced-draft-fan inlet. Four thermocouples are installed in the boiler

PRINCIPAL EQUIPMENT FOR NEW UNIT
Pittsburgh Plate Glass Co.

Boiler, Sterling type, 45 tubes wide.....Babcock & Wilcox Co.
Boiler heating surface, 15,147 sq. ft.; water-wall surface, 1,800 sq. ft., max. continuous steaming capacity 180,000 lb. per hr.; working pressure, 900 lb. per sq. in.; total steam temperature, 750 deg. F.; furnace volume 9,200 cu. ft.; max. B.t.u. liberated per hr. per cu. ft. of furnace volume, 27,200.
Superheaters, 5,440 sq. ft.....Babcock & Wilcox Co.
Economizers, 8,247 sq. ft.....Babcock & Wilcox Co.
Steam scrubber.....Babcock & Wilcox Co.
Soot blowers.....Diamond Power Specialty Corp.
Boiler setting, sectionally supported.....H. M. Detrick Co.
Furnace heat insulation.....Philip Carey Co.
Stack (Gunite lined).....Pitts. & DesMoines St. Co.

Combustion Equipment

Stoker, Taylor, with zone air control, active grate area 451 sq ft.....American Engineering Co.
Stoker drive 10-hp. adjustable-speed direct-current motor
Clinker crusher, with Hele-Shaw hydraulic drive
American Engineering Co.
Ash hopper.....Allen-Sherman-Hoff Co.
Forced draft fan, 70,000 c.f.m. at 70 deg. F.
American Blower Co.
Drive 150-hp. geared turbine.....De Laval Steam Turbine Co.
Induced-draft fans, 120,000 c.f.m. at 450 deg. F.; 12 in. differential pressure.....American Blower Co.
Drive, 340-hp. 4,000-r.p.m. geared turbine
De Laval Steam Turbine Co.
Coal-handling-equipped extension.....Link Belt Co.
Weigh larry.....Link Belt Co.

Control and Valves

Water columns.....Yarnall Waring Co.
Feedwater regulators.....Bailey Meter Co.
Automatic combustion control.
Smoot, Republic Flow Meters Co.
Safety valves.....Crosby Steam Valve & Gage Co.
Blowoff valves.....Cochrane Corp.
Non-return valves.....William Powell Co.
Atmospheric relief valves.....Atwood & Morrill Co.
Extraction non-return valve.....Schutt-Koerting Co.
Feedwater valves.....William Powell Co.
High- and low-pressure valves.....William Powell Co.
Reducing valves.....Schutte Koerting Co.
Desuperheater and control.....Schutte Koerting Co.
Electric valve operators, Limitorque...Philadelphia Gear Works

and economizer outlets so that flue-gas temperature may be taken on any one of each group of four points or an average reading of any combination of the four thermocouples may be obtained. A thermocouple is installed in each of the two intakes to the forced-draft fan and an average temperature of the two recorded.

An automatic control allows deaerator-water temperature to be adjusted at will. Three pressure gages complete the metering equipment on the boiler panel. Valves in the high-pressure steam header may be opened or closed by electric valve operators and the stoker motor on a Hele-Shaw pump motor for the clinker-crusher drive are started and stopped by push-buttons on the boiler board. Coal is taken from the overhead bunker by a larry and weighed to the stoker. The weigh larry and meter records and those obtained from flue-gas and feedwater analysis permit the boiler to be operated under practical test conditions at all times.

The boiler supplies steam to a 6,250-kw., 3,600-r.p.m. turbine that is bled at 400 lb. (one of the highest bleed pressures used), and exhausts into the 140-lb. header, Fig. 2. The turbine, practically a tandem unit with a 400-lb. bleed connection between its two sections, is built with a single cylinder and rotor. Automatic control of the bleed is provided for by a duplicate of the high-pressure steam chest and valves on the 400-to-140-lb. section. This type of bleeder valve was selected because of the very high bleed pressure, considered too high for the usual grid valve, at present limited to about 200 lb. per sq.in. Steam in the high-pressure element, after expanding through the nozzles, passes through a single-velocity impulse stage and then to a reaction element. Beyond the bleed point, the steam expands through another set

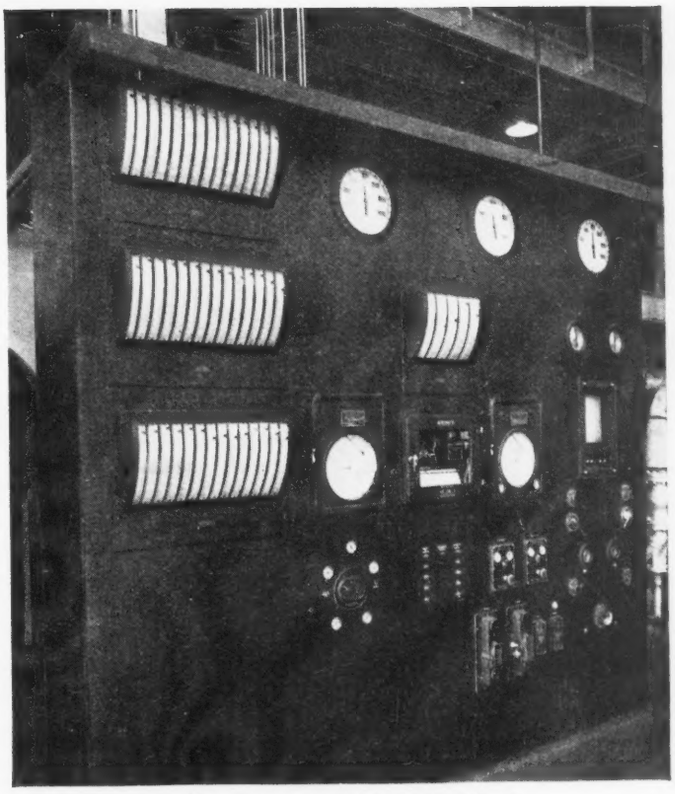


Fig. 6—From this meter and control board the boiler is operated under practical test conditions at all times

of nozzles and passes through a single-velocity impulse stage and a second reaction element.

The turbine connects to a 6,250-kva. 0.80-p.f., 3-phase, 60-cycle, 2,300-volt alternator. Later, a 1,000 -kw., 250-volt geared d.-c. machine will be coupled to the alternator, provision having been made in the foundation for doing this. When the second high-pressure boiler and turbines are installed, all power will be generated on these units and the older 140-lb. units shut down.

At the turbine, meters are provided for intelligent operation and for steam distribution. Indicating gages show steam-header pressure at the throttle, primary—, extraction— and exhaust-steam pressures. Other gages show governor-oil, gland-water and gland-leakoff pressures. A 3-point meter for the extraction steam and another for the exhaust records steam flow, pressure and temperature at these points. Five steam-flow meters record and integrate the 400-lb. and 140-lb. steam distribution to the different departments in the plant. A temperature recorder and controller regulates the temperature of the 140-lb. steam obtained through reducing valve and desuperheater from 400-lb. line.

The equipment has been in operation for sufficient time to compare its performance with the estimated saving on which the design was based. About 25 per cent less steam is required with the high-pressure unit than with the old ones for comparable loads and the coal saving exceeds that estimated by a good margin.

The plant was designed by R. S. Clark, division power engineer, and his engineering staff, working with Charles W. E. Clarke, consulting engineer of Philadelphia.

Piping and Traps

Pipe heat insulation.....Philip Carey Co.
Expansion joints.....E. B. Badger & Sons Co.
Traps.....Yarnall Waring Co.
Piping contractor.....Pittsburgh Piping & Equipment Co.

Feedwater Systems

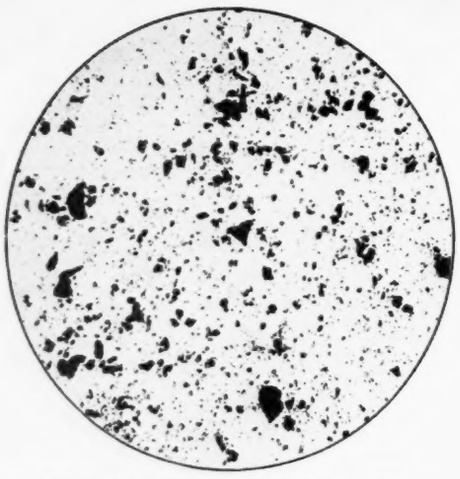
Boiler-feed pumps, 2, 8 stage, single suction, 400 g.p.m., suction 250 lb., discharge, 1,050 lb. per sq. in. Ingersoll-Rand Co.
Drive, 270-hp. turbines.....De Laval Steam Turbine Co.
Booster pumps, 2, 1,200 g.p.m., 50 ft. head, turbine driven.....De Laval Steam Turbine Co.
Auxiliary feedwater heater, 200,000 lb., from 225 to 325 deg. F.....C. H. Wheeler Mfg. Co.
Deaerator regulator control.....Taylor Instrument Companies
Feedwater treatment, Hall system.....Hagan Corp.

Meters

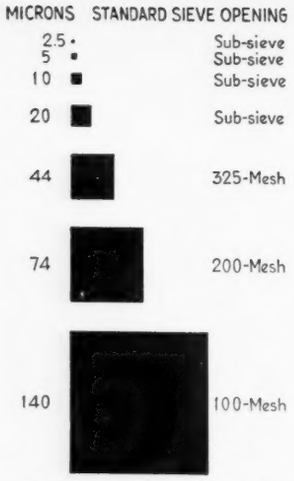
Boiler meters.....Bailey Meter Co.
Steam-flow meters.....Bailey Meter Co.
Feedwater-level recorder.....Bailey Meter Co.
Boiler-pressure gages.....Crosby Steam Valve & Gage Co.
Turbine-pressure gages.....Westinghouse Elec. & Mfg. Co.
Turbine-speed indicator.....James G. Biddle Co.
Pressure gages, recording.....Bailey Meter Co.
Temperature recorders.....Bailey Meter Co.
Temperature recorder, 7 pointer.....Leeds & Northrup Co.
Temperature recorder.....Taylor Instrument Companies
Thermometers, industrial.....Taylor Instrument Companies
Draft gages, 3-14 pointer, 1-5 pointer...Ellison Draft Gage Co.
Flus-gas analyzer.....Ellison Draft Gage Co.

Generating Unit

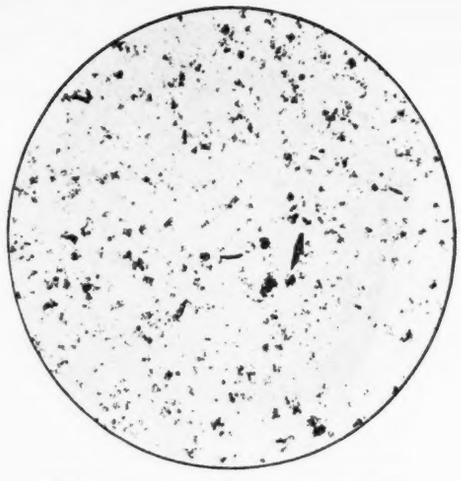
One, 6,250-kw., 3,600-r.p.m. turbine, designed for 850 lb. and 825 deg. F.; throttle conditions 825 lb., 750 deg. F.; extraction automatically 400 lb., exhaust 140 lb. back pressure.....Westinghouse Elec. Mfg. Co.
Turbine connects directly to 6,250-kva. 0.80 p.f. 3-phase, 60 cycle, 2,300-volt Westinghouse alternator; geared to a 1,000-kw. 250-volt, 720 r.p.m. General Electric d.c. generator.
Generator air cooler.....Westinghouse Electric Mfg. Co.
Turbine oil cooler.....Westinghouse Electric Mfg. Co.
Turbine oil purifying system.....S. F. Bowser & Co.
Oil pump.....S. F. Bowser & Co.
Motor generator set, 60-hp. squirrel-cage motor connects to 40-kw., 125-volt d.-c. generator Westinghouse Electric Mfg. Co.
Switchboard and oil circuit breakers.....General Elec. Co.
Transformers.....Allis Chalmers Mfg. Co.
Crane.....Shaw Box Crane & Hoist Co.
Consulting Engineer.....Charles W. E. Clarke



Pulverized-fuel ash screened through 325-mesh, 132 magnifications



Scale for comparison of particles



Dust escaping a mechanical collector. Largest particles about 16 microns. Combustible content at minimum

What Dust Is A Nuisance?

By Louis C. Whiton. Jr.

President, Prat-Daniel Corp.

REMOVAL of dust, especially from the stacks of pulverized-fuel installations, has become a matter of increasing importance to steam-plant owners and especially to manufacturers of pulverized-fuel equipment. Consideration of what constitutes dust of the most objectionable quality to the community is therefore timely.

The following is a sieve analysis of dust taken by sampling devices from the flues in a large central power station fired with pulverized fuel, and gives an idea of the type of product that must be handled by dust-collecting equipment:

	Test A Max. steam load	Test B Max. load	Test C 70% of max. load	Test C 57.5% of max. load
On 100 mesh.....	4.6%	6.5%	5.0%	10.5%
Thru 100 on 200..	19.3	16.5	9.5	9.2
Thru 200 on 300..	13.5	23.5	12.5	9.0
Thru 300.....	62.6	53.5	73.0	71.3
	100.0%	100.0%	100.0%	100.0%
Combustible in dust	37.9%	39.5%	10.0%	12.2%

These tests are of interest because it is to be noted that at high ratings the dust is considerably coarser than at lower ratings. This is, of course, partly due to the firing conditions and degree of coal pulverization at different ratings as well as the settling of a greater amount of coarse material in the ducts, flues and other parts of the boiler installation with a lower velocity of gas at the lower ratings.

Ultimate pulverization of the coal before firing does not necessarily determine the fineness of the pulverized-fuel ash after firing, as there are many factors which enter. Fusion point of ash and furnace temperature determine whether several molten particles of ash fuse together to form larger particles. Vice versa, larger particles may be fractured into smaller ones by violent contact with the apparatus through which the dust passes, such as the boiler setting, air heater, fans and ducts.

Determination of the fineness of the dust in the gas must be made upon samples taken directly from the flues rather than the analysis of samples of the product collected by dust collectors. Depending upon the type of dust collector used, the dust may be finer or it may be coarser than that contained in the flue gas. After observation of many samples, I suggest that the following analysis is probably a fair average of the ash contained in the flues of pulverized-coal installations: On 100-mesh, 5%; thru 100 on 200, 15%; thru 200 on 325, 20%; thru 325, 60%.

Although the quantity of dust in the flue gas is of importance, the quality is of equal interest. The analysis of the sample of dust given below happens to be that collected by an electrostatic dust collector and, therefore, probably with a lower percentage of coarse particles than the dust in the gas, but the analysis of the combustible in the ash of various mesh dusts is, in all likelihood, the same as the dust in the gas itself.

The combustible in the ash collected was 22.2% and the following shows the percentage of combustible in the various meshes: On 100-mesh, 61.2%; thru 100 on 200, 43.4%; thru 200 on 325, 34.7%; thru 325, 15.35%.

The importance of this from the standpoint of the quality of dust is two-fold. In the first place, it is evident that the coarser particles will settle more rapidly than the fine dust. Furthermore, the coarse particles will be more quickly observed, especially in the neighborhood of the plant emitting the dust. Complaints will, therefore, result to a greater degree, blame will be more directly

attached, and the average person will, of course, observe the coarse particles more readily than particles as fine or finer than dust contained in the normal atmosphere stirred up in the daily routine of life. In the second place, the coarse particles are blacker in color, and the higher percentage of combustible undoubtedly makes them more objectionable to the public.

Theoretical consideration of the distance that a particle of dust will travel in the atmosphere before it will fall a given distance to the ground, can be made by the use of Stokes' Law. If we consider that the average stack is 100 to 125 ft. high and that the gas with its dust rises upwards an additional 25 or 50 ft. before it assumes a horizontal travel with a moderate breeze of 5 m.p.h., the following calculation shows the distance that a particle must travel before it would drop 150 ft. and reach the ground:

Mesh	Micron Size	Distance of Travel
100	149	220 ft.
200	74	960 ft.
325	44	2,625 ft.
Sub-mesh	11	7.9 miles

With increasing velocities of wind, the distances will increase in proportion. In other words, a 100-mesh particle with a 30-m.p.h. wind will travel a distance of 1,320 ft., whereas an 11-micron particle will travel a distance of 47.4 miles.

As is well-known, it is the particular feature of mechanical collection to remove more readily the coarser particles than the smaller particles. If two methods are considered, both of which, for example, will collect 90% of the dust, it is evident that a method which allows only the ultra-fine dust to escape has considerable advantages over a method which allows coarse dust to escape and precipitate upon the nearby community.

Until recently, it has been considered that mechanical methods were capable of collecting only about 80% of pulverized-fuel ash, but the recent advancement in the art, especially with moderate-sized cyclones properly controlled so that they will be efficient at the various ratings of the boiler, has resulted in the perfection of mechanical means of collection to a much greater extent than formerly. Tests have indicated conclusively that better than 90% can be obtained with pulverized-fuel ash, which is as much as 75% to 80% through 325-mesh screen. Microscopic measurements on the dust escaping the more efficient types of cyclone collectors indicate that the size of the average particle escaping is between 3 and 10 microns (44 microns being 325-mesh), with an occasional particle showing a maximum size of 19 microns.

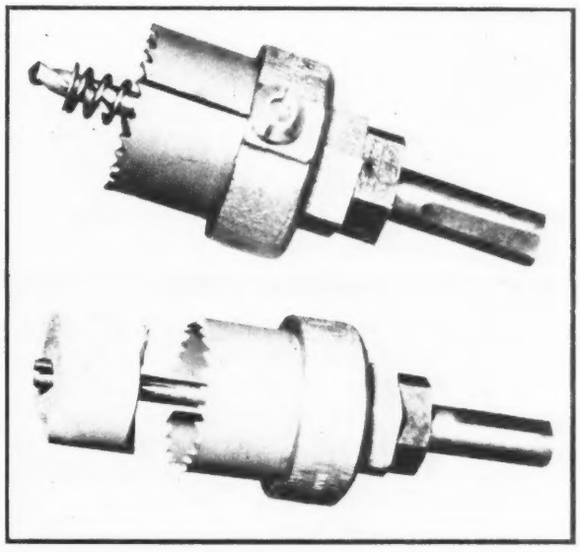
Thus it can be reasonably concluded that the kind, size and quality of the dust escaping the dust-removing apparatus should be considered as well as the quantity escaping. It may even be that from the standpoint of public relations, the quality is of equal or greater importance than the quantity, which has always previously been considered of prime importance.

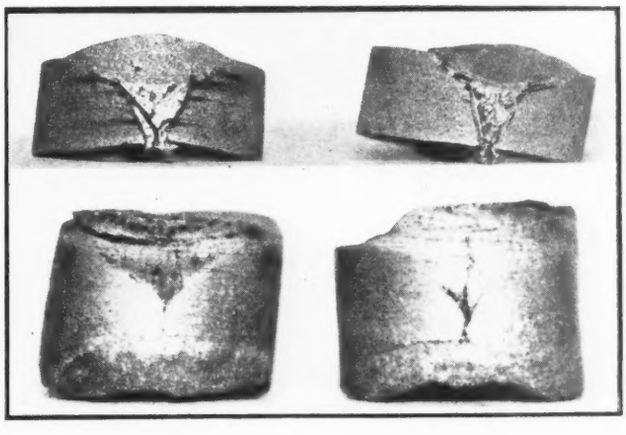
A Plug Tells the Story

HARTFORD Steam Boiler Inspection & Insurance Co. has recently investigated a number of questionable welded pressure vessels by trepanning, at several points, plugs from the welded seam and then etching these plugs to detect lack of fusion or slag inclusions. The tool used is shown in the upper illustration with the pilot drill in place, and again below with a plug caught on the split pilot.

A hole is drilled with the pilot drill, and then the split pilot replaces the drill and is passed through the hole. Its spring action causes it to spread after it passes through, thus causing the enlarged section at its end to hold the plug securely. The circular saw blade is of the new high-speed steel. The drilled hole is tapped and filled with a 1 or 1¼-in. pipe plug, so that if the weld is sound, the vessel is not impaired.

Plugs are sectioned, polished and deep-etched in a boiling solution of equal parts of hydrochloric acid and water. The lower photographs show plugs cut from a fusion-welded ammonia brine cooler and from an ammonia generator. Both show defective welds and resulted in replacement of the vessel—*From an article by Wm. D. Halsey, assistant chief engineer, Boiler Division, Hartford Steam Boiler Inspection & Insurance Co., in "The Locomotive."*





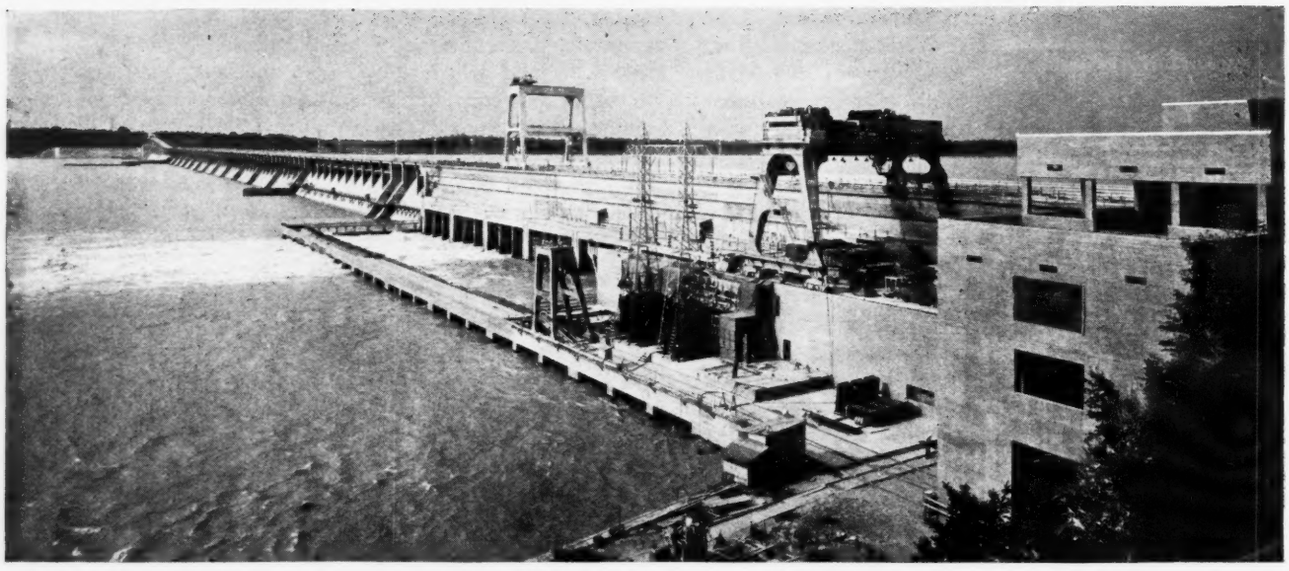


Fig. 1—Wheeler power house and dam, 15.5 miles above Wilson Dam in Alabama, have a total length of 6,335 ft.

Record Propeller Turbines for Wheeler Dam Plant

Outdoor-type plant on the Tennessee River provides for eight 45,000-hp. propeller-type turbines to operate under 48-ft. head, the highest-power units of their kind in the world

WHEELER DAM project in northwestern Alabama is the next step above Muscle Shoals in developing the Tennessee River for navigation and power generation. Now nearing completion, it is the second project on the river system constructed by the Tennessee Valley Authority. An interesting feature is the power house without a superstructure, the crane and generating unit being designed for outdoor operation.

The dam, Fig. 2, a concrete-gravity structure 6,335 ft. long, has a maximum height in the spillway section of 72 ft. above the foundation. It will form a reservoir having 1,260,000 acre-ft. total storage capacity, and will provide 9 ft. navigation for 74.1 mi. up the river, backing the water to Guntersville dam now being built. For a complete plan of development of the river, see July *Power,* pages 354, 357. At its north end is a 60 x 360-ft. navigation lock with a 50-ft. lift, and at its southern end the power house has been built. Between the power house and lock a spillway 2,700 ft. long provides for a flood of 650,000 sec.-ft. Near the power house and lock a trashway 45 ft. long will pass trash over the dam from either side of the river.

The spillway is divided into twelve sections 225 ft. long, separated by training walls. Piers on the spillway crest divide each of the sections into five parts, each closed by a radial gate 40 ft. long by 15 ft. high. These gates are hinged near the downstream face of the pier, Fig. 4, and are raised and lowered by individual hoists in the inspection tunnel running through the dam.

Because of the large size of the units and the low head, it has been found economical to omit the superstructure from the power house and design the main generators for outdoor operation. Generators will be provided with a circular metal covering which the operator can enter from the top through manholes between each set of air coolers, with sufficient space inside to allow an operator to pass around the machine for inspection. Space for eight main units is provided in the power-house structure, with an assembly bay below generator-floor level at the south end of the plant, Fig. 5, where the operating room is also housed. A standard-gage railroad track runs into the assembly bay and can be reached by the 270-ton gantry crane spanning the power house, to handle heavy parts.

In the top of the assembly bay are two round hatches, normally closed by metal covers. These are large enough in diameter to pass the completely assembled stator or runner of one unit. Two 4-ton electric hoists in the assembly bay assist in handling parts. Assembling of main-unit parts, and major repairs are made there. The 270-ton gantry crane has sufficient capacity to lift and transport the heaviest part of a main unit. Transformers are assembled in a bay at one end of the control building, equipped

with a 75-ton crane, from where they can be transported by car directly to their operating position. Oil switches may be handled in the same way.

Only two units are now being installed, each rated 45,000 hp. at 85.7 r.p.m., under a 48-ft. head. The turbines are of the fixed-blade propeller type, but provisions have been made in the power-house superstructure to install Kaplan-type runner on future units if desirable.

These runners are the highest-powered, fixed-blade, propeller-type units built, and have rubber-lined, water-lubricated guide bearings. For propeller-type runners they are exceeded in capacity only by two 66,000-hp. Kaplan units being installed in Bonneville plant on the Columbia River. At full head of 48 ft., each unit discharges 8,920 ft. of water per sec. for 45,000 hp.

Large runners of this type are likely to give trouble from pitting and vibration, due to cavitation, unless set low enough to maintain pressure in the runner above the vapor pressure of the water. In this installation, the runners are placed with their center line 6 ft. below normal tailwater level, and 13 ft. below maximum tailwater elevation, Fig. 3. Tests on a model runner indicated that this location gives a safe margin above the cavitation limit. Under normal head the value of sigma for the runner is 0.8. The model operated satisfactorily under a pressure-drop coefficient as low as 0.6.

Because of their large diameter, the hub and six blades of each runner, which are of cast steel, were made separately and then assembled. This design also permits more accurate setting of the blade than is possible with a single casting. It also simplified shipping the runners, which are 22 ft. in diameter, by assembling only four blades on the hub, the other two blades being connected to the hub at the plant.

Twenty-four guide vanes were found experimentally to be the most efficient number. This gives less overhang over the distributor ring than would a smaller number, and will therefore tend to reduce cavitation difficulties in the draft-tube throat. These gates are 13 ft. 4 in. high, bearing-to-bearing of vane, and their stems are cast integral. The head cover is built in two pieces, bolted together, and so designed that it and the runner can be lifted out as a unit.

Because of the large area of the turbine gates and the comparatively high head (48 ft.), there would normally be considerable leakage through them when they are closed. Provisions have been made to depress the water level in the draft tube with compressed air to give a back-pressure on the turbine gates equivalent to about a 16-ft. head of water. Under these conditions, head on the gate will be about 32 ft., and leakage is reduced to a small part of what it would be otherwise. Only a little make-up air is necessary to maintain pressure in the turbine casing.

As is evident from Fig. 3, water passages from the intake to the scrollcase are short and of large cross-section, making difficult accurate measurement of the large flow, 8,920 sec.-ft. at full load. Because of these difficulties and the cost of making field tests, it was agreed by TVA engineers and the manufacturer that the latter was to build a homologous model unit, including racks, intake, casing and draft tubes. This model was to be tested in the manufacturer's hydraulic laboratory and the stepped-up results were to be accepted as the performance of the large unit. This has been done, and the turbines will be accepted without being tested in place.

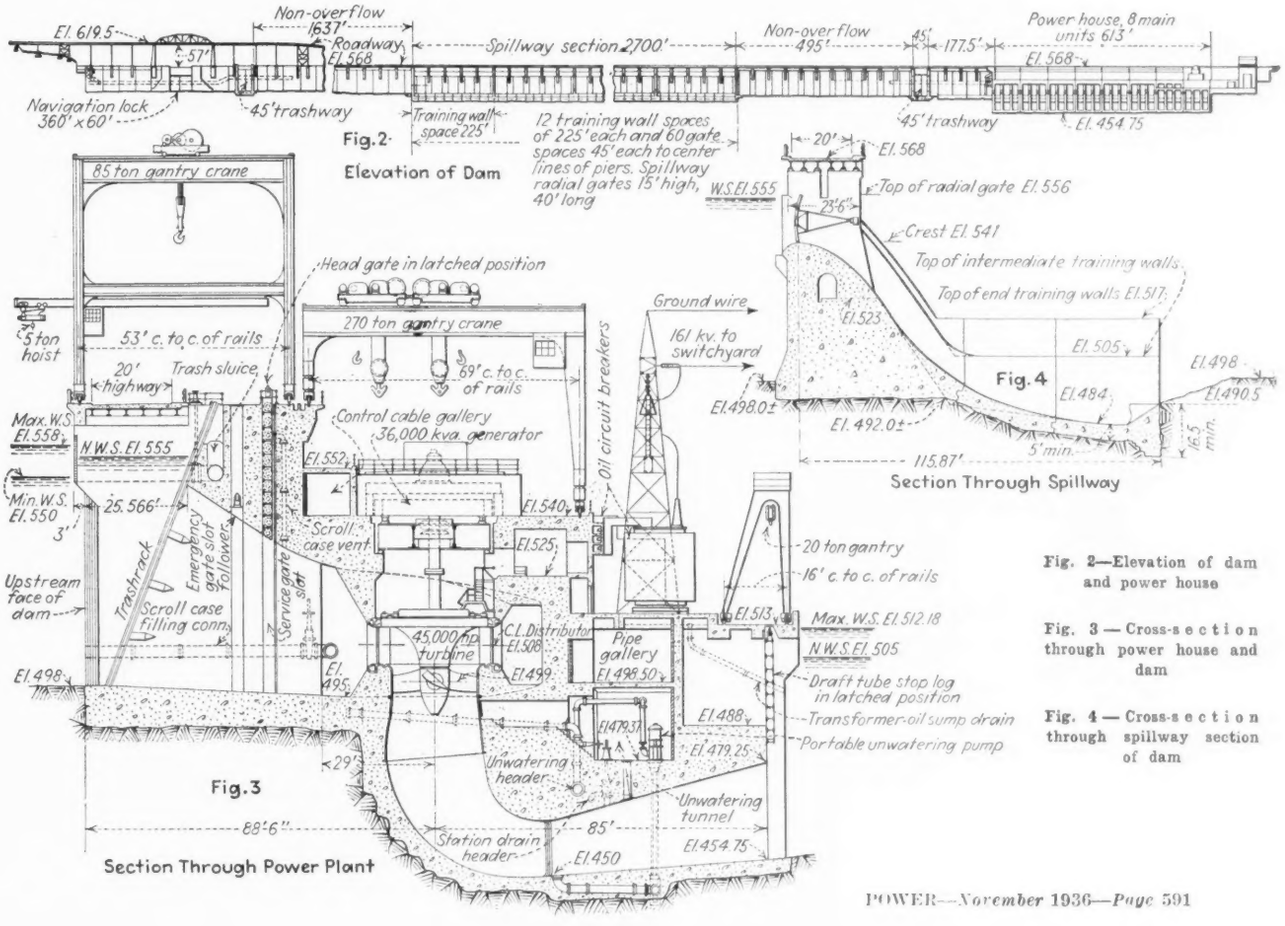


Fig. 2—Elevation of dam and power house

Fig. 3 — Cross-section through power house and dam

Fig. 4 — Cross-section through spillway section of dam

All hydraulic engineers will probably not agree that the stepped-up results of a model unit is a true measure of its prototype's performance. However, many stepped-up model-test results have been compared with those obtained from field tests, and in most all cases they have checked within the limits of error. In general, the field tests have shown a slightly higher efficiency than the stepped-up model test.

For example, the stepped-up model efficiency of a runner 11 ft. in diameter was 90.9%, and the field-test efficiency of the prototype 92%. In another installation with a runner 7 ft. 9 in. diameter, the stepped-up model efficiency was 90.6% and the field test showed 91%. These units are smaller than the Wheeler runners, but these results and others do show that it is possible to get a close check between stepped-up model tests and those on the prototype.

The generators are of the outdoor type, rated 36,000-kva. 0.9 power factor, 13,800 volts and 60 cycles. In physical size, they are the largest outdoor units ever built, and for machines of this type are exceeded in power only by the 56,000-kva. generators in the Island Power & Light Co. Ariel station. Each unit has an over-all diameter of 43 ft. and is approximately 18 ft. 2 in. high above its base, including the pilot exciter.

A closed ventilating system, using surface air coolers, has been provided. Not only are the usual advantages of a cool, clean generator obtained but for an outdoor station such as this the closed ventilating system greatly simplifies the station arrangement, since no provision for supplying or discharging generator air is required. The closed ventilating system is also well suited to using CO_2 protection, with which the machines are equipped.

Eight surface aircooler sections for each machine have been vertically arranged equally spaced around the generator-stator frame, thereby occupying a minimum of floor space. Outside the cooler sections and extending from the power-house deck to approximately 1 ft. above the top of the coolers, a circular ventilating casing also serves as the vertical section of the weatherproof generator housing. This also supports the roof over the generator and exciters.

PRINCIPAL EQUIPMENT FOR WHEELER-DAM PLANT

Turbines, propeller type, 2	I. P. Morris Division, Baldwin Southwark Corp.
Governors	Woodward Governor Co.
Generators	General Electric Co.
Thrust bearings, spring type	General Electric Co.
CO_2 fire protection	Walter Kidde & Co., Inc.
Generator air coolers	General Electric Co.
Oil-treating equipment	DeLaval Separator Co.
Oil tanks	Stacy Mfg. Co.
Storage battery	Gould Storage Battery Co.
Battery charging equipment	Electric Products Co.
Power transformers	Westinghouse Elec. & Mfg. Co.
Service transformers	General Electric Co.
Small power and lighting transformers	Maloney Electric Co
Service-unit gasoline engine	Buffalo Gasoline Motor Co.
Service-unit generator	Ideal Electric Mfg. Co.
High-voltage circuit breakers	Westinghouse Elec. & Mfg.
High-voltage disconnect switches	Delta-Star Electric Co.
Generator oil switches	Westinghouse Elec. & Mfg. Co.
Service oil switches	Westinghouse Elec. & Mfg. Co.
Lightning arresters	Westinghouse Elec. & Mfg. Co.
Service switchboard, 2,400 volt	Delta-Star Electric Co.
Auxiliary switchboard, 440 volt	Westinghouse Elec. & Mfg. Co.
Main switchboards	Westinghouse Elec. & Mfg. Co.
Automatic synchronizing equipment	Westinghouse Elec. & Mfg. Co.
Station gantry crane	Alliance Machine Co.
Head-gate gantry crane	Harnischfeger Corp.
Draft-tube stoplog gantry crane	Alliance Machine Co.
Service-bay hoists	Euclid Armington Eng. Corp.
Transformer assembly crane	Bedford Foundry & Machine Co.
Spillway gate hoists	Clyde Iron Works Sales Co.
Trashway gate hoists	Clyde Iron Works Sales Co.
Spillway gates	Lakeside Bridge & Steel Co.
Trash gates	Pittsburgh-Des Moines Co.
Head gates	Bartlett Hayward Co.
Dewatering and sump pumps	Aurora Pump Co.
Oil pumps	Schutte & Koerting Co.
Oil pumps	Geo. D. Roper Corp.
Generator air-cooler service pumps	Yeomans Bros. Co.
Air compressors	Worthington Pump & Machinery Corp.
Penstock flowmeters	Simplex Valve & Meter Co.
Headwater- and tailwater-level indicators and recorders	Julien P. Friez & Sons Co.
Elevator	Warner Elevator & Mfg. Co.

Generating units will be operated in hydraulic and electrical pairs and are equipped for automatic synchronizing. Units Nos. 1 and 2 will constitute the first pair. Each generator of the pair may be connected through an oil switch to the delta bus of the 72,000-kva. transformer bank, which comprises three 24,000-kva., 13,400- to 89,000-volt units connected delta-star, giving 154,000 volts on the switchyard busbars. Station-service power is supplied by a 2,000-kva. bank of 13,200-volt to 2,400-volt transformers connected to the 72,000-kva. transformer delta bus. Provisions have been made for a second 2,000-kva. service bank when units Nos. 3 and 4 are installed. Emergency sources of station power will be supplied from Wilson dam and a gasoline-driven generating unit.

The main generators, transformers, and service transformers have differential relay protection similar to the equipment at Norris dam plant, described in August *Power*.

Those directly responsible for the project include Arthur E. Morgan, chairman and chief engineer of the Tennessee Valley Authority; Carl A. Bock, assistant chief engineer; B. W. Steel, chief designing engineer; and T. B. Parker, chief construction engineer. W. M. Hall, as construction engineer, and George P. Jessup, as superintendent of construction are in charge of the field work.

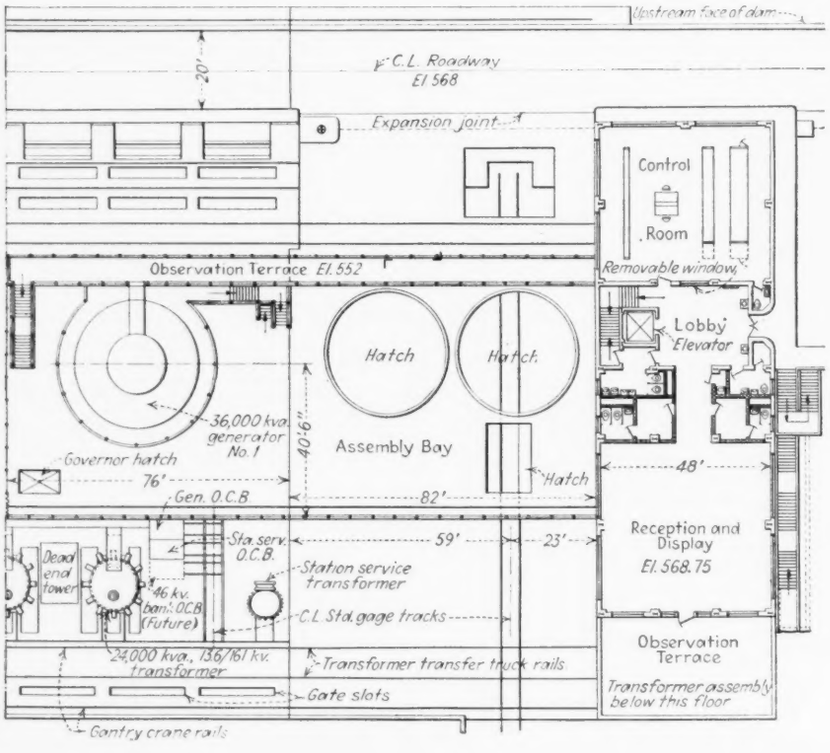
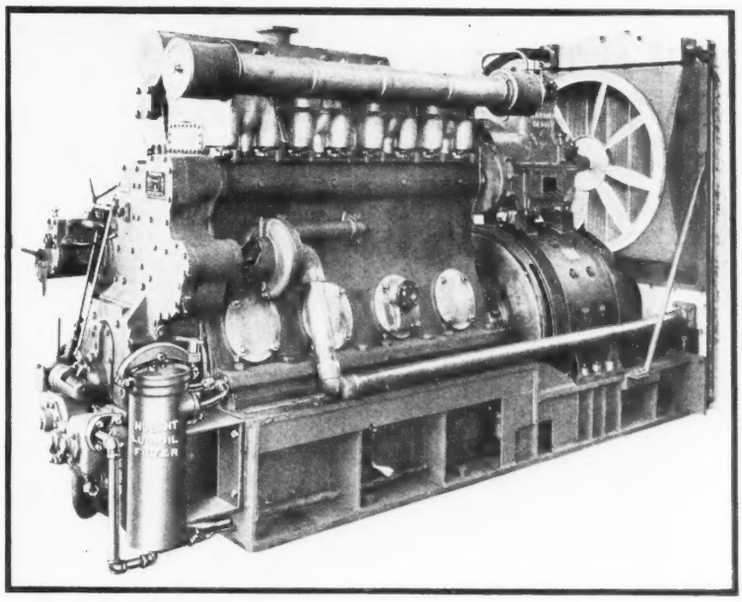


Fig. 1—Pressure-type filter installed on a diesel provides continuous purification of the lubricating oil



What Makes Bad Oil Good

How lubricating oil can be purified for diesels, steam turbines and steam engines, and compressors

By James I. Clower

Asst. Prof. of Machine Design
Virginia Polytechnic Institute

NO SINGLE method of purifying lubricating oil is best suited for all operating conditions and machines. Purification methods must be matched to the nature of the impurities involved and the operating conditions of the machine. Methods of purification may be divided roughly into three principal groups: 1, batch; 2, continuous; and 3, combination batch and continuous.

Batch purification provides for withdrawing the entire volume of oil, preferably while still hot, and running it into a settling tank. This oil should be permitted to remain quiet in the tank for at least ten days. During this time, water and insoluble impurities gravitate to the tank bottom and much of the sludge, soluble in the oil at the normal operating temperature, becomes insoluble and settles out. Batch settling is the only generally accepted method at present for reducing the soluble content of lubricating oils.

Fig. 2—Batch settling tanks for lubricating oil

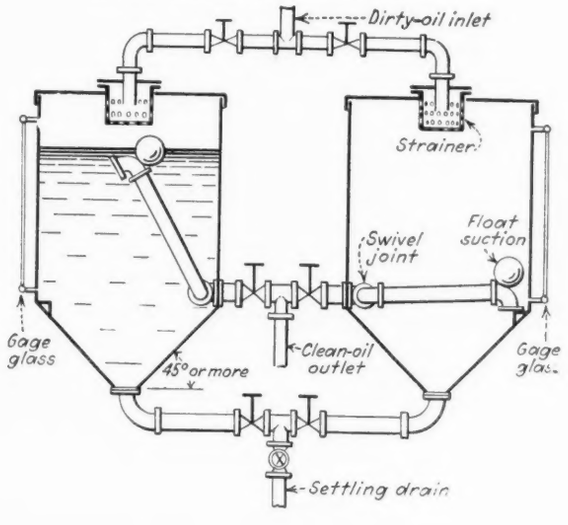
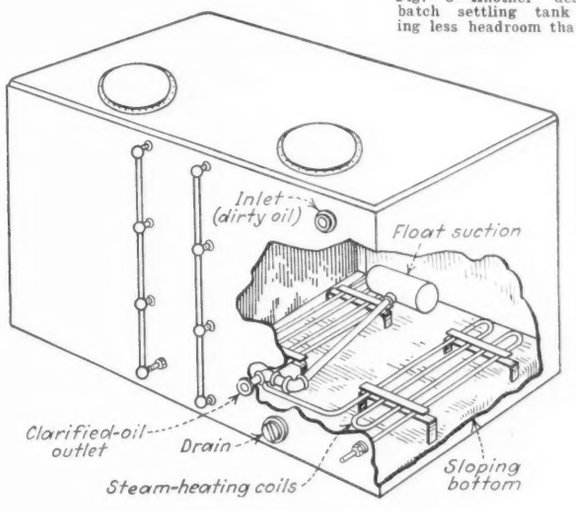


Fig. 3—Another design of batch settling tank requiring less headroom than Fig. 1



For the purpose of increasing the rate of settling, batch settling tanks are sometimes provided with steam-heating coils. Fig. 2 shows a batch settling tank without heating coils, and Fig. 3 one with these coils. Obviously, where time will permit, more thorough clarification is obtained without coils. Furthermore, practically no settling will occur while the oil is being heated, because of the convection currents created.

Clarified oil should be withdrawn with care to prevent remixing the settlings and oil. This can be done by providing a float suction, as in Figs. 2 and 3.

Disadvantages of this method are: 1. Two complete batches of oil are generally required. 2. It is generally necessary to shut down the machine to change the oil. 3. Considerable space is required for settling tanks. 4. At least ten days are required for thorough

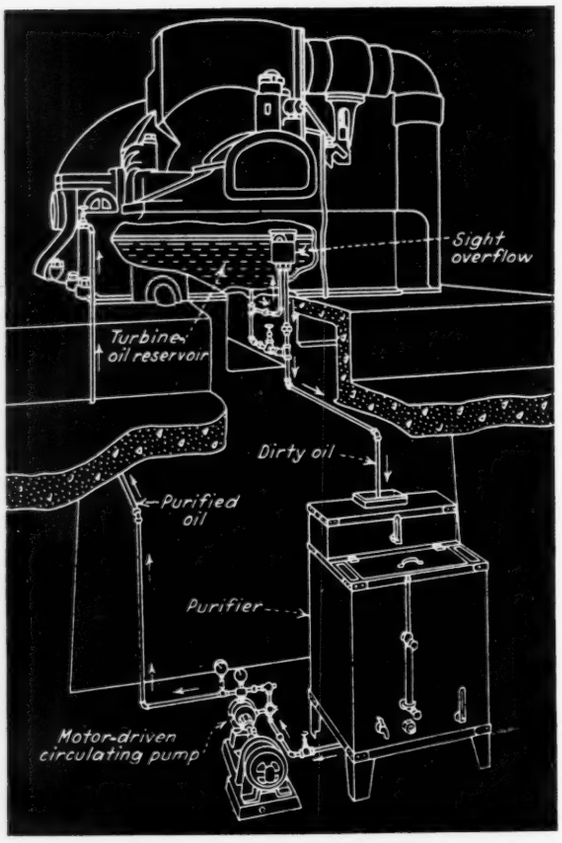


Fig. 4—Continuous bypass oil-purifying system applied to a steam turbine

clarification. 5. Impurities are not removed as they collect, but build up to some predetermined concentration at which time the batch is withdrawn and purified. Obviously, for a considerable period the oil may be rather heavily loaded with impurities and is practically never clean. Under certain conditions, disadvantages 2, 3 and 4 are not of any consequence. For example, in many instances the schedule of oil purification can be arranged to coincide with regular shutdowns for cleaning and overhauling.

In general, equipment required for batch purification is relatively inexpensive and simple. The purifier itself is generally easily made and may be only an old discarded steel drum or wooden barrel. It is recommended however, that where any considerable quantity of oil is to be purified that a special tank or tanks be obtained similar to those of Figs. 2 and 3. It will usually be found advisable to provide two tanks and, wherever headroom is available, conical bottoms are recommended. This type of bottom, if sloped 45 deg. or more, makes the tank practically self-cleaning.

Batch purification is adaptable to all mineral oils, such as those commonly used for lubricating steam turbines and engines, diesel engines, air and refrigerating compressors, and other similar machines.

Continuous purification provides for continuous cleaning of all or any part of the oil each cycle as it is circulated through the system. When only a part of the oil flows through the clarifier each cycle, it is commonly called a bypass purification system, Figs. 4, 5 and 6. Continuous purification may be simply a fine-mesh metal screen or strainer, a cloth strainer, or it may be any one of several designs of gravity and pressure-type filters, or centrifuges of various types and designs. Construction and operating principles of these purifying devices will be discussed in subsequent articles.

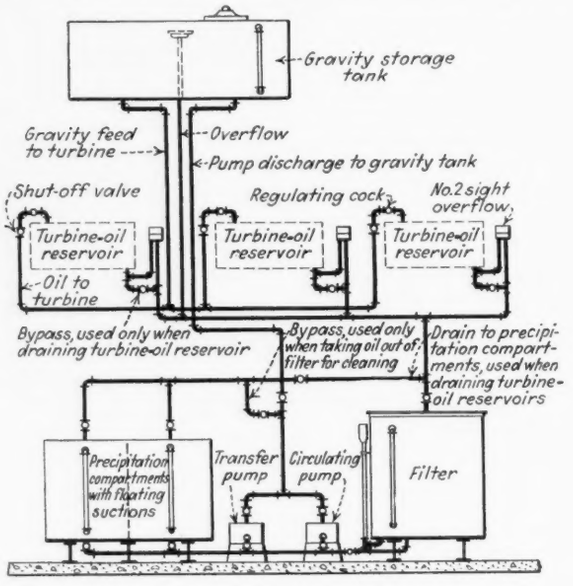


Fig. 7—Combination batch and continuous-bypass oil-purifying system arranged so that one filter and one pair of batch settling tanks serve three turbines

Screening is the simplest and one of the most commonly used methods of continuous purification. It is frequently used in combination with other devices and methods to relieve other parts of the purifying system of wear and tear. Its use is limited to removing the coarse contaminants, such as metal chips and

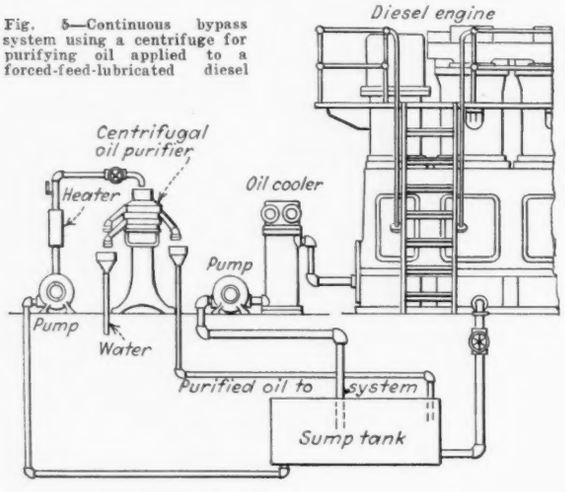


Fig. 5—Continuous bypass system using a centrifuge for purifying oil applied to a forced-feed-lubricated diesel

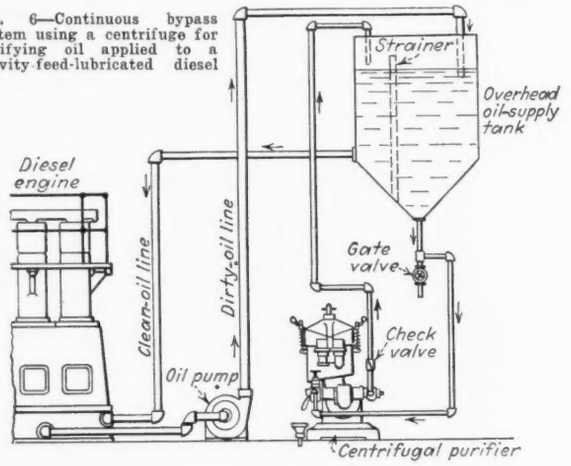


Fig. 6—Continuous bypass system using a centrifuge for purifying oil applied to a gravity-feed-lubricated diesel

particles, grit and scale, etc. Soluble sludge, acid constituents, water, the finer insoluble-sludge particles and atmospheric dust, cannot be removed by screening.

The continuous method of purification, where all oil flows through the clarifying device, has the disadvantages that the equipment required, in most instances, is large; its initial cost is out of proportion to the savings; and only a relatively small proportion of the soluble products of oxidation are effectively removed. Comparatively recently, however, small, high-capacity pressure filters have been designed which largely overcome the first two disadvantages. These will be described in later articles.

In the bypass system of continuous purification, oil is taken from the reservoir bottom where water, sludge and other impurities collect, and a portion of it passed through the purifier, the remainder being circulated as usual. The purified oil is returned directly to the main reservoir.

In this method, usually about 10% of the oil per cycle is circulated through the clarifier, hence, the equipment is smaller and costs less than when all oil is passed through. The degree of purification of the oil is much less than when all oil is passed through the clarifier each cycle. In either case, soluble products of oxidation, etc., are not removed, so that their concentration gradually increases. This concentration eventually becomes so high that the oil must be changed, or else batch treated to remove them.

Combination batch and continuous purification in most instances is a combination of the batch and the bypass methods. The bypass part of the treatment partially removes water and other insoluble impurities while the oil is in service. This retards the rate of oxidation and guards against formation of severe emulsions. The batch treatment periodically removes all insoluble impurities and reduces soluble impurities to a point at which they are no longer a detriment. This method is very widely used for purifying steam-turbine oils.

Safe Control of Oil Burners

By James O. G. Gibbons
Consulting Engineer

MANY types of oil burners lend themselves readily to semi-automatic, or "high and low," control, when operating with "bunker C" fuel oil. Such burners could be provided with automatic ignition, so that completely automatic control through extinguishing and relighting of the burner flame could be obtained.

As a rule, a control which reduces the flame to a safe minimum as boiler pressure rises, and increases it as the demand for steam increases, will take care of industrial operating conditions. Likewise, it is quite safe to install apparatus which will cut off the oil supply entirely and so extinguish the flame when boiler pressure reaches a maximum, or if desired, when water in the boiler falls too low. But in starting up again, it is far safer to relight the burner by hand.

Oil burns as a gas and not as a liquid; the problem, therefore, is similar to that encountered in operation of a gas-fired furnace, it being imperative to guard against accumulation of dangerously explosive gas-and-air mixtures before ignition.

When the flame is extinguished, and oil automatically comes on again within a short time, unless ignition occurs almost immediately, liquid oil will be sprayed onto the hot furnace brickwork and a dangerous amount of gas may be generated before it can ignite.

In the mechanical-pressure burner, it is important that the tip be withdrawn when the flame is extinguished, otherwise radiant heat from the furnace setting will probably carbonize oil in the orifice. This eventually makes burner cleaning necessary, but when the burner is started up, it is likely to spill improperly atomized oil into the furnace. This may lead to an explosion.

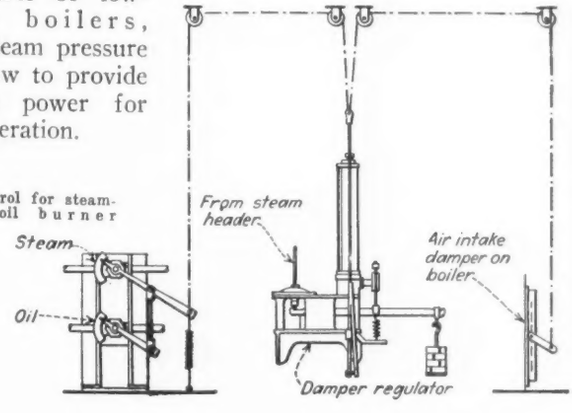
With most burners, it is possible to control operation by a damper regulator arranged to control both oil and air supplies. In steam-atomizing burners, both steam and oil supplies should be controlled together. Some insurance companies demand that an interlocked automatic valve be installed to shut off the oil in case steam supply fails.

With hand operation, the oil and steam supplies may be controlled separately, but where automatic or semi-automatic control is furnished, the steam and oil valves should be interlocked, and operated by the same mechanism.

It is always advisable to provide a hand shut-off valve in addition to the automatic control valve or cock, in both oil and steam feeds to the burner, as well as a cross steam connection, so that steam may be blown through the burner for cleaning.

For the semi-automatic control, any good make of damper regulator may be used. This may be hooked up to control air-intake dampers as well as both oil and steam valves, a typical control hook-up being shown.

As a rule, straight mechanical operation of the controls, as indicated, will be satisfactory, but it is sometimes preferable, to install an electric switch actuated by boiler pressure, and provide motor operation for valves and dampers. This method is particularly suited to the control of low-pressure boilers, where steam pressure is too low to provide adequate power for direct operation.



Simple control for steam-atomizing oil burner

SCALING of TURBINE BLADING

By C. Richard Soderberg

Head, Turbine Department
Westinghouse Electric & Manufacturing Co.

THE FIRST evidence of scale in a steam turbine is loss of capacity, partly due to a reduction in the area of the steam passages and partly to decreased efficiency due to roughness of the passage walls and distortion of the shapes. If stage-pressure readings are taken regularly at a given load, these pressures will be found to increase as scaling progresses and may be used to determine the rate at which scaling is taking place. To maintain capacity, it is necessary that scale be removed by some practical method, and this introduces a widely varying element of risk of injury to the turbine. If the scale is left on and the turbine permitted to stand still, severe corrosion will set in, especially in the presence of moisture.

Boiler water always contains a certain amount of impurities. These impurities are carried over into the steam principally by water drops, but some of the impurities will evaporate directly and mix with the steam in the form of a gas.

The amount of these impurities varies over wide ranges. Best conditions are obtained in condensing plants with a minimum of make-up; industrial plants with 100% make-up naturally offer the most serious problems. Make-up water containing 30 p.p.m. of impurities is considered excellent and can be obtained only when a large amount of condensate is used. Many plants have to operate regularly with as much as 500 p.p.m. Even with the best obtainable feedwater treatment, however, a concentration in the drums of 150 p.p.m. is not unreasonable, and it may go as high as 3,000 p.p.m. If the evaporation product in the drums contains 1% of moisture, a common figure, the steam admitted to the superheater contains from 1.5 to 30 p.p.m. of impurities. The lower limit is probably below the actual values encountered in most installations.

Chemical composition also varies over wide ranges, depending on the nature of make-up and steam pressure. Nature of the make-up water depends partly upon the original properties of the water and the treatment to which it is subjected. One important object of this treatment is softening, which safeguards against insoluble scale in the boiler as well as in the turbine. Another common object is to safeguard against embrittlement by modifying the ratio of sulphates to alkalinity. These and other circumstances result in certain constituents almost always being present. Under normal conditions impurities are soluble compounds, the insoluble impurities having been removed as far as possible. Of the former, the following are the most important: sodium chloride, sodium sulphate, sodium carbonate and sodium hydroxide. The insoluble compounds are usually silica and salts of calcium and magnesium.

This mixture is now transmitted to the superheater where the temperature is raised to the final value. The impurities undergo certain changes, depending on their nature. The majority probably crystallize into a fine dry dust, but it is not impossible that some melt into a liquid while others may evaporate into a gas.

Although the percentage of these impurities may not be large, it is important to remember that the steam flows of modern plants are so large that literally tons of these salts may pass through the turbine. Assuming a flow of 1 million lb. per hr. and 1 p.p.m. of impurities in the steam, there will pass through over 700 lb. of salts per month. Even if the major part of these pass through to the exhaust, there will remain enough to upset the blade-path conditions after a few weeks of operation.

Mechanism of Scalding in Turbine Blading

With expansion there is a gradual change in the physical properties of the impurities in the steam. Those compounds that retain their original nature of a dry dust will blow through the blading until they are again dissolved into the condensate at the wet region. Experience shows, however, that most of the compounds present in the boiler water are found attached to various portions of blading.

Several theories have been advanced to explain this. The most probable explanation is that as the temperature is lowered, some of the components become sticky and attach themselves to the blading. It is probable that only a small percentage of the impurities may form the bond for much larger masses of dry material. It is possible also that some of the deposits may take place in a manner similar to the scaling of boiler tubes where the deposits are formed by precipitation of crystals from the liquid. Recent study of actual data from power plants by Mr. Straub has shown that deposits may form at any temperature or pressure; that the deposits are not proportional to the concentration of the boiler water; and that all deposits observed contained sodium either in the form of hydroxide, carbonate or silicate. Stickiness of the impurities is most probably caused by sodium hydroxide, which remains sticky at the temperatures and pressures involved.

Whatever the actual nature of the mechanism of scaling, there are certain fairly general observations which are worth considering and which are listed in the following:

1. Scaling occurs over a fairly well defined range of temperature (or pressure). It is seldom serious in the early stages and it generally disappears altogether as the dewpoint is reached. No reliable observations have been made with regard to the limits of temperature at which scaling is recorded, but it is rarely pronounced above 550-600 deg. Inlet valves and chambers are seldom scaled seriously.

2. Scaling is usually confined to the path of the main steam flow, the leakage path seldom showing

appreciable deposits. This is probably because leakage flows are generally so small that no appreciable amount of impurities is passed.

3. While deposits in most cases are scattered over the entire blade surface, usually the narrowest sections of the passages show the heaviest deposits. The convex side of the blading usually scales first, although as the deposits increase in thickness increasing portions of the blade surfaces become covered.

It has been suggested that since the narrow passages tend to scale first, the rate of scaling would in some way be dependent upon steam velocity, the higher the velocity the greater the rate of scaling. It seems more reasonable, however, to assume that scaling takes place only in places where the flow tends to leave the wall and form active eddies. With clean blades this is most apt to occur at points of maximum velocity, and preferably on the convex side of the blades. As the scaling progresses, eddies are extended over wider areas until the major part of the blade is covered.

4. In reaction blading the stationary and rotating rows scale at approximately equal rates.

5. The composition of the soluble scale taken from turbine blading exhibits certain general characteristics illustrated by the following examples:

	Case A				
Compound	*From inlet*	*From outlet*	*Case B*	*Case C*	*Case D*
Sodium chloride % ..	46	12	53	61	8
Sodium sulphate %	3	2	22	1	18
Sodium carbonate %	8.5	80	11	28	70
Sodium hydroxide %	1	..	4.5	..	..

The non-soluble components of the scale consist chiefly of silica.

6. Scaling is confined to installations of comparatively high inlet steam conditions. In the central-station field, the principal offenders are 650- and 1200-lb. pressure installations. In the industrial field, several 400-lb. pressure plants have encountered the trouble. Superheat does not appear to be of fundamental significance.

Removing the Scale by Washing

It is usually possible to prevent formation of non-soluble scale by proper feedwater treatment, so that the problem concerns chiefly the removal of scale soluble in water. There are two fundamentally different methods available for doing this. Perhaps the easiest from the point of view of the turbine is to shut the machine down, let it cool off, and then slush the blade path with hot water. This is rarely possible, however, since it requires a shutdown of several days, and it is only a little simpler than dismantling the turbine. The other method, which is more common is to desuperheat the steam before the throttle in gradual steps until it contains a certain amount of moisture. Operation is continued under these circumstances for a few hours, at the end of which scale will usually have disappeared.

It is evident that this method represents a severe strain on the turbine, even when done in the most careful way possible. It may cause serious distortions of turbine parts unless the temperature changes are made uniformly.

A procedure suggested for an 18,000-kw., 3,600-r.p.m. turbine supplied with steam at 650-lb. pressure and 850 deg. follows:

a. Note the steam flow at throttle and the load carried at full secondary opening. Also note the secondary inlet pressures as well as the exhaust pressure.

b. Slowly reduce the load until a throttle flow of 30 to 45% of full-load flow is obtained.

c. Move spindle into the start-and-stop position.

d. Reduce pressure and temperature at throttle evenly from normal to 600 lb. and 750 deg. over a period of not less than 1 hr.

e. Open wide all drains where water will accumulate. This includes drains from the high-pressure turbine equilibrium pipes and cylinder cavities.

f. With throttle conditions held constant, slowly open one of the water-control valves. This should be done so that the temperature at the turbine inlet drops evenly in as straight a line as possible. Continue opening additional valves until the temperature at the turbine inlet is approximately 10 deg. above saturation temperature corresponding to the pressure at the turbine. *The minimum time for desuperheating should be 2 hr.*

g. After the 10 deg. superheat point has been reached, maintain the turbine in operation for 2 hr. at constant throttle conditions. If necessary adjust the water nozzles to maintain 10-deg. superheat at the primary inlet.

h. At the end of the 2-hr. washing period, gradually reduce the water supply over a period of 2 hr. taking care that an even temperature increase is obtained.

i. Ten minutes after closing the last water nozzle, close all drain valves.

j. Move the spindle into the running position.

k. Gradually add load until the secondary valve is full open and check the effectiveness of the washing by noting steam flow, load and pressures.

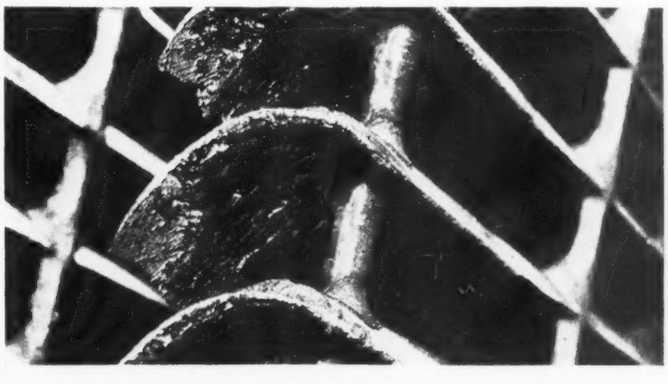
Operator should watch the vibration indicator throughout the washing process and occasionally listen for rubs. Should vibrations or noise of any unusual character develop, the machine should be taken off the line.

Temperature readings at the turbine inlet should preferably be taken by a recording thermometer.

It is important to hold temperature at the inlet 10 deg. above saturation temperature. If the temperature is allowed to drop to saturation temperature the amount of moisture at the inlet will be unknown. If the superheat at inlet is greater than 10 deg. the amount of moisture in the turbine will be less and render washing less effective.

There are no standard methods for removing non-soluble scale, and it is usually necessary to resort to some process of mechanical abrasion. Blasting with pulverized coal-ash and using stiff-tooth brushes with grinding compound have been used.

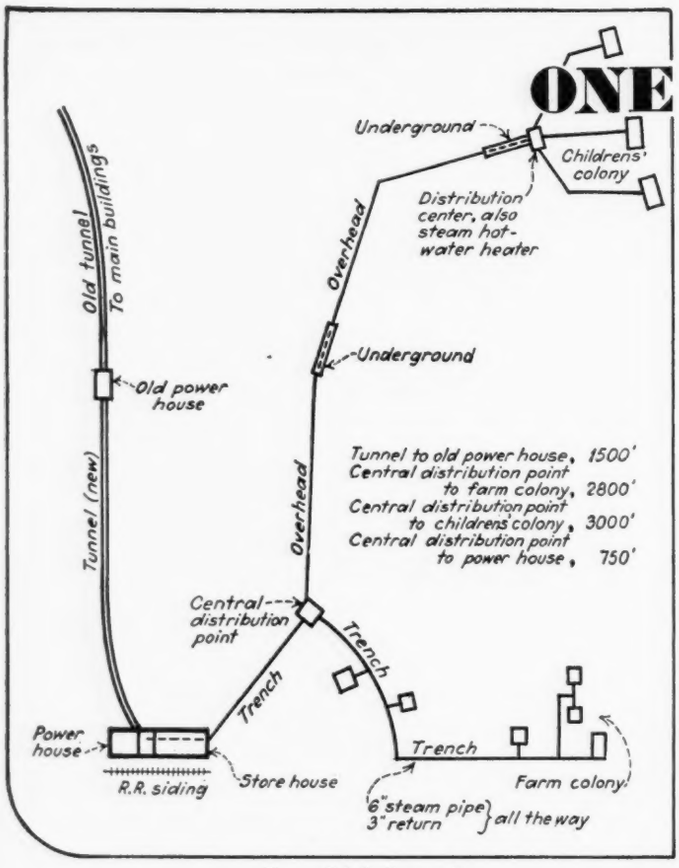
Many suggestions have been made that one or the other of the principal types of turbines is superior in its ability to operate under adverse conditions of impure steam. But the only fair interpretation that can be given to the data available is that both types of turbines are equally susceptible, and neither can claim immunity from the difficulty in large sizes.



ONE PLANT Heats Many Buildings

Monson (Mass.) State Hospital scrapped nineteen small boiler plants and built one with only three boilers, increasing over-all efficiency 20%

By Edward C. Brown
Consulting Engineer
As Told to Francis A. Westbrook



Steam distribution system

MONSON State Hospital, Monson, Mass., has installed a new boiler plant to replace equipment which had become inadequate and inefficient. This institution comprises a large tract of land with a main group of buildings, a farm colony about ½ mi. away and a childrens' colony slightly over ¾ mi. away. Original boiler equipment consisted of four h.r.t. boilers for the main group of buildings, nine iron boilers (one in each building) at the farm colony and nine similar boilers at the children's colony. The four boilers for the main group were in a small boiler house but the other eighteen were all in separate buildings at some distance from headquarters.

This meant a great deal of coal trucking, often over icy roads, and a corresponding amount of individual attendance. Also, if anything went wrong with one of the individual boilers, the building was left without heat or hot water. This might have serious consequences. Furthermore, as this is an institution for epileptics, patient labor is undesirable.

Obviously the thing to do was to concentrate the heating plant for the whole institution in one building and make it as economical to operate as practicable. A site was selected to which a railroad siding could readily be constructed for the delivery of coal and supplies and which would also be suitable for a modern storehouse. Location of this site relative to the institution buildings is shown in the diagram of the steam distribution piping.

First, let us see what equipment was installed in the power house. Three 3,300-sq.ft. longitudinal 2-drum, straight-tube boilers (Erie City) designed for 250-lb. pressure were installed. Space was also provided for a fourth boiler, and for an engine room in which a turbo-generator will be installed later.

Boilers are fired with Westinghouse underfeed stokers having a continuous rating of 200%, and have successfully carried peaks of 250%. They are also equipped with deaerating, metering feedwater heaters, Bailey boiler meters, draft gages, and CO_2 recorders, and are automatically controlled by the Hagan system. Boiler feedwater is handled by a turbine-driven pump, a motor-driven centrifugal pump or a vertical marine-type reciprocating pump. The latter is used for lightloads and in summer, and was selected because exhaust steam from it is not contaminated with oil. The turbine-driven pump is used normally, except in summer, and the motor-driven pump is held for standby service. There are also turbine-driven and motor-driven forced-draft fans, the latter being used if there is no use for the exhaust steam from the turbine.

Coal is brought in on the siding and dumped into a pit from gondola cars. At the bottom of the pit there is a single-roll, Stephens-Adamson crusher. Crushed coal is elevated to a 200-ton overhead steel bunker and evenly distributed by a belt conveyor equipped with a tripper. It is discharged from the bottom of this bunker through clamshell gates into a travelling weigh-larry provided with a Richardson automatic weigh scale. This larry, which is electrically operated, is used to fill the stoker hoppers. In cases where coal is to be stored outside in the storage yard it is dumped from cars into the pit as already explained, but instead of being crushed at once it is immediately elevated to the top of the bunker and bypassed through a spout from which it falls to the ground. Ashes are handled by a "Steammatic" conveyor system and delivered to a silo outside the boiler house, from which they are trucked away for use on the roads about the grounds.

Steam is generated at 200 lb. pressure and is reduced to 60 lb. for distribution. Reduction from boiler pressure to 60 lb. is made through two reducing valves in parallel. One is of large capacity, other of small capacity, so arranged that the smaller valve will operate on light loads and prevent chattering

of the large valve. They are both of removable-cage chronometer type and are controlled by step-action regulators. These reducing valves are in the boiler house. Others at each building reduce the pressure to whatever is desired. Another feature of the outside steam-distribution system is that it has been installed so that return pipelines, from outlying buildings can be supplied with steam in case of emergency.

General layout of the buildings, the distances and method of running the pipelines is shown in the diagram. Thus a tunnel was constructed from the new boiler house to the old boiler plant. This tunnel is 1,500 ft. long, and large enough to permit of passenger traffic and to care for steam and electrical services. The old tunnel between the old boiler house and the main group of buildings was retained, thus the steam piping between the new boiler house and the main group is all in tunnels. All pipelines are welded.

Next it will be noted that the childrens' group and the farm colony are served by a separate line from the power house. This is run through a trench to a central distributing point. From this, there is an overhead line to the childrens' group, with an underground section where it crosses a road. An underground line runs to the farm colony. Valves have been installed at the central distributing point so that either branch may be shut off or so that return lines may be used for steam lines in case of necessity. In addition to this it was, of course, necessary to install expansion joints.

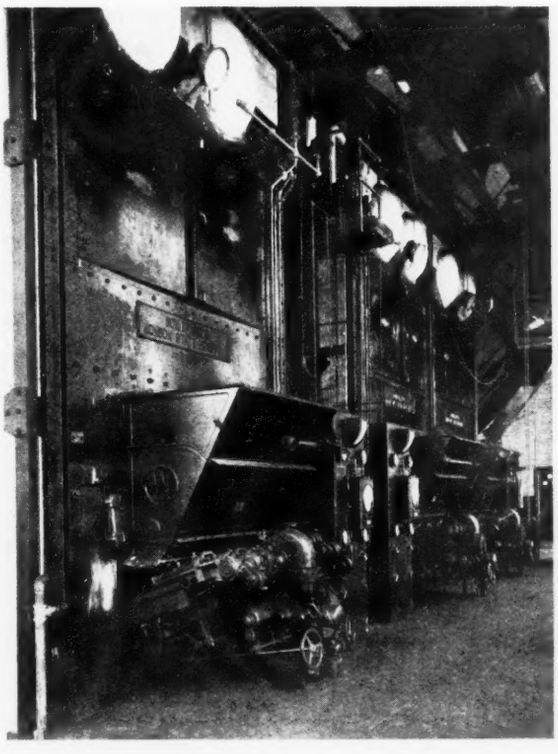
Overhead construction was employed for the line to the childrens' group because it was less expensive than trench construction, due to the character of the ground to be traversed. That is, there are ledges of rock and the ground is very uneven and for this run there was no need of hiding the pipes as they are in a gulley. A stream was crossed under a roadway bridge. The construction consists of vertical steel supports on approximately 12-ft. centers. Each support consists of two galvanized-steel pipes with angle cross-arms from which the pipes are hung with adjustable rollers. Vertical supports are set in concrete foundations, and their lower 6-in. is especially protected with bitumastic compound to prevent corrosion. Expansion-joint and anchorage supports are built up of steel framing with particular attention to rigidity. Pipelines are covered with double-thickness sponge asbestos, over which is applied hair felt. The whole is covered with a weatherproof jacket with lapped and sealed joints. Both the steam and return lines have been insulated this way.

Trench construction is of concrete with the pipes supported on adjustable rolls suspended from the walls. The tops of the trenches are just above the surface of the ground and the covering consists of removable concrete slabs. Pipes are insulated similarly to these in the overhead line, except that the hair felt has been omitted.

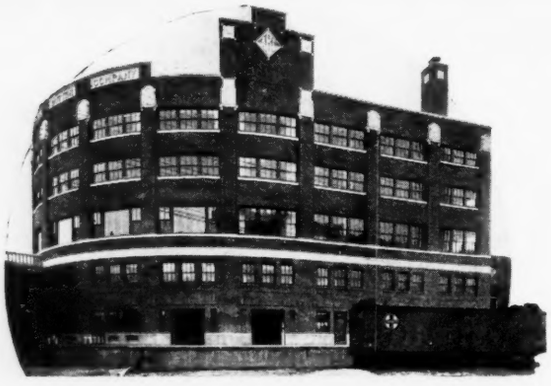
Each building presented a different heating problem. Some had 2-pipe steam heating, others had hot-water gravity heating, which was inadequate in the case of the dormitories in the childrens' group. Consequently, the steam-heated buildings were provided with reducing valves to secure steam at the proper pressure, and the buildings with hot-water heat were equipped with steam-heated hot-water generators, having thermostatic control to limit the temperature of the hot water according to the temperature inside the building. In the childrens' colony, dormitory circulating pumps were installed on the hot-water system to boost the effective heating, which has proved to be satisfactory. Centrifugal circulating pumps were used.

From the standpoint of performance, the new steam plant has accomplished several important results. It has eliminated patient labor and greatly reduced the handling of coal. In fact it has saved 50 cents a ton for handling alone, and it has raised the over-all efficiency some 20%. The old boilers were in bad shape, their maintenance was very high, and occasionally there was a breakdown somewhere. Of course the whole heating service was greatly improved, and additions to the institution were taken care of and provision made for future expansion. One fireman per shift, with an assistant engineer in the daytime, handle the whole plant.

Boiler fronts, showing stokers and control boards



Central distribution point and beginning of overhead steam line. Boiler house in background



One of the largest Midwest butter plants

Steam for Butter

Here are facts and figures on a plant which supplies power services to produce 6,500,000 lb. of butter a year, as well as hog and poultry feed. Refrigerating compressors are steam driven, but all other power is purchased

By Floyd C. Hicks

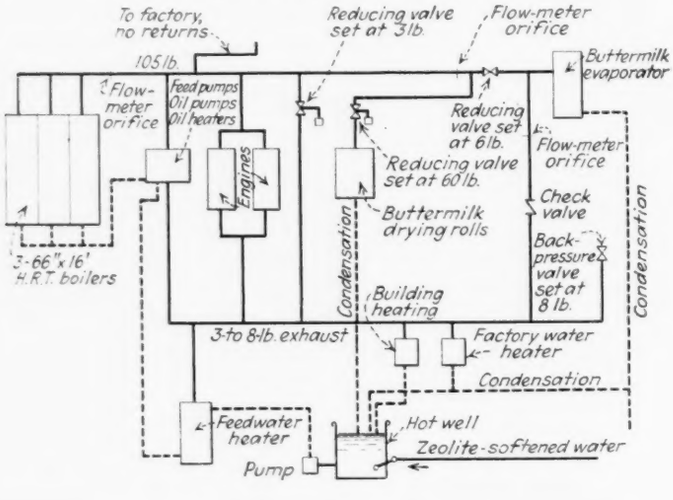
Plant Engineer, American Butter Co.

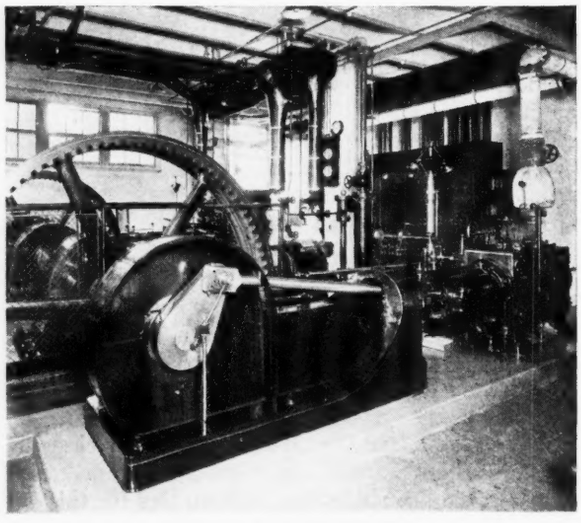
THE American Butter Co., Kansas City, Mo., a unit of American Dairies, Inc., is one of the largest plants in the Middle West devoted to making butter, having a capacity of 6½ million pounds per year. Equipment is also installed for condensing and drying byproduct buttermilk for hog and poultry feed.

Some power for refrigeration is made with steam engines, but all factory power and lighting is purchased. Almost every kind of power and heating service is required in the factory. Steam at 100-lb. pressure is used for driving ammonia compressors and steam pumps, for pasteurizing cream and sterilizing cream vats and sanitary pipes, in a towel and white-clothing laundry for employees, and on steam-heated rolls for drying buttermilk. Low-pressure steam from 3 to 7 lb. is used for buttermilk evaporators, for heating water for plant use, heating feedwater, and winter building heating. Refrigeration is required for cooling cream, cooling four cold-storage rooms, cooling water for butter rinsing and for drinking, and cooling the butter-cutting and wrapping room to 70 deg. F. Compressed air is required for operating temperature controls, spray painting, etc. Electric power operates the churns, vats, pumps and lineshafts.

All exhaust steam from engines and pumps goes into a common exhaust line, at the end of which is a backpressure valve set at 8 lb. All steam for building heating, feedwater and factory-water heating is taken off this line, any excess going through a check valve to the buttermilk evaporator, which draws a total of 9,000 to 10,000 lb. of steam per hr. Exhaust steam

Steam-flow diagram for the plant





The two 50-ton steam-driven refrigerating compressors

available averages 3,000 lb. per hr. on a normal day, the difference being made up with live steam through a reducing valve at this point. Steam coils of the evaporator are drained by six 1-in. Armstrong traps. All condensation returns to a tank in the boiler room and is pumped to the feedwater heater. This amounts to 40% of total steam generated. Makeup feedwater (18-grain) passes through a 24-g.p.m. Permutit zeolite softener and is controlled by a low-level float in this tank. For one hour daily, raw city water is used as makeup to keep down pitting and corrosion in the boilers. The Erie City open feedwater heater brings the temperature up to 225 deg. F. for the boilers. No other water treatment is used.

A Republic indicating and recording CO_2 meter can be used on any boiler through a valve arrangement (we feel that a recorder for each boiler would not pay in a plant of this size). CO_2 averages 12% for the operating day. Total steam from all boilers is metered with a Republic indicating and recording steam flow meter, the indicator being installed in the boiler room for guidance of the fireman.

In the engine room, two 14 x 36-in. Twin City corliss engines are direct-connected to 50-ton Wolfe-Linde ammonia compressors ($12\frac{13}{16}$ x $21\frac{3}{16}$ in.) There is also a $7\frac{1}{4}$ x $7\frac{1}{4}$-in., 15-ton, Baker ammonia

compressor belted to a 30-hp. a.c. R. & M. motor.

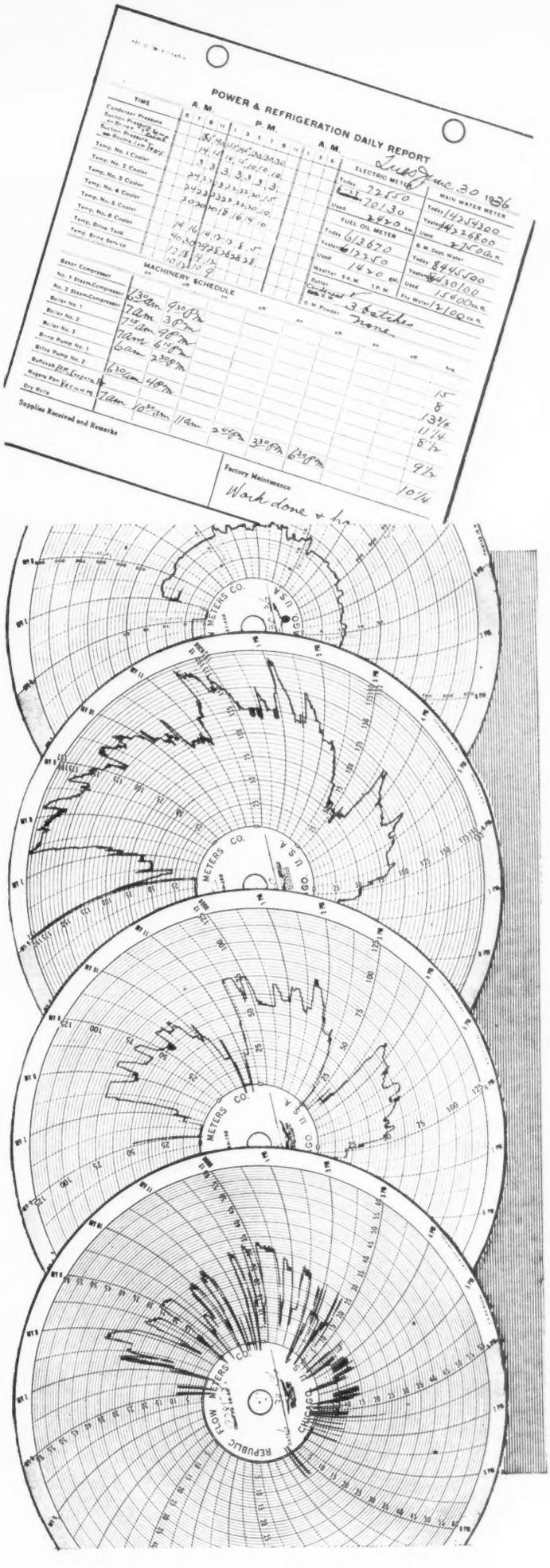
Calcium-chloride brine is cooled in two 16 x 16-in. (one Carbondale, one Frick) shell-and-tube brine coolers, and in turn cools cream in the vats. Brine is also used for cooling the butter-cutting and wrapping room and chilling water for butter rinsing and for drinking. Other refrigerating equipment includes four York 16 x 16-in. enclosed shell-and-tube ammonia condensers, a Hill non-condensible gas separator, and a Marley roof spray pond. A 19-c.f.m. Gardner-Denver compressor provides process air.

Because it is so perishable, fresh cream received must be pasteurized, cooled and churned immediately. Volume handled varies from day to day and week to week, according to the weather; for example, about 65% of the year's volume is handled in five summer months. This causes a very low load factor on machinery, particularly refrigerating equipment. It also causes high overloads, and variable steam demand, thus reducing the efficiency of the boiler plant. Including all blowoff and idle-time radiation losses for the boilers, average evaporation runs 99 lb. of steam per gallon of oil, with 225-deg. feedwater and a 105-lb. steam pressure. This varies from day to day, because feedwater temperature varies with changes in exhaust-steam pressure on the heater and stack losses at various loads. Stack temperature on a 19,000-lb. steam load runs 750 deg. F., on a 9,000-lb. load, 400 to 425 deg. F.

When the plant was built in 1923, two 66-in. by 16-ft. Kewanee h.r.t. boilers were installed. Since then a Hedges-Walsh-Weidner boiler of the same size and type has been added. Each is rated at 1,000 sq.ft. and set 6 ft. above the floor line. All boilers are heavily loaded, peaks reaching 22,000 lb. of steam per hr., with a 16,000-lb. per hr. average, during the day, but with a low load of 3,000 lb. per hr. in the evening. They are cut in and out according to load, and no spares are available, all three being used daily except for opening up one at a time for inspection every six months. In June, for example, we produced 3,879,000 lb. of steam.

We burn 10 to 12 Beaumè gravity fuel oil, having 154,000 B.t.u. per gal. at 60 deg. F. Oil is passed through a disk meter at 125 deg. F., then preheated to 180 deg. F., before reaching the Leintz steam-atomizing burners. With the average evaporation of 99 lb. of steam per gal. of oil, and oil costing 90 cents per barrel of 42 gal., the average fuel cost is 21.6 cents per 1000 lb. of steam. In June, we burned 39,130 gals., or 931.6 bbl., at a cost of $838.44.

Fuel oil is received in tank cars and flows by gravity to two 15,000-gal. underground concrete tanks. Solid rock was so close to the surface that steel tanks large enough could not be installed. Concrete was therefore poured on top of the rock footing, the floors and walls being monolithic and the surface treated with "Ironite." In thirteen years of use, no leaks have developed.



Top—A typical daily report, showing the blank. Punched for two holes at the top, it is filed in a 2-ring binder. Below, in order are the CO_2, total steam, live steam to buttermilk department, and exhaust steam to buttermilk department, all for June 30. Total steam was 139,875 lb., requiring 1,420 gal. of oil. The three batches of buttermilk condensed cause readily recognizable dips in steam demand. Live steam to buttermilk totaled 53,500 lb., exhaust 15,600 lb., a total of 69,100 lb.

Direct expansion is used in the cold-storage rooms. They total 40,000 cu.ft. in four rooms, are for short-time storage only, and temperatures range from 5 deg. F. to 25 deg. F.

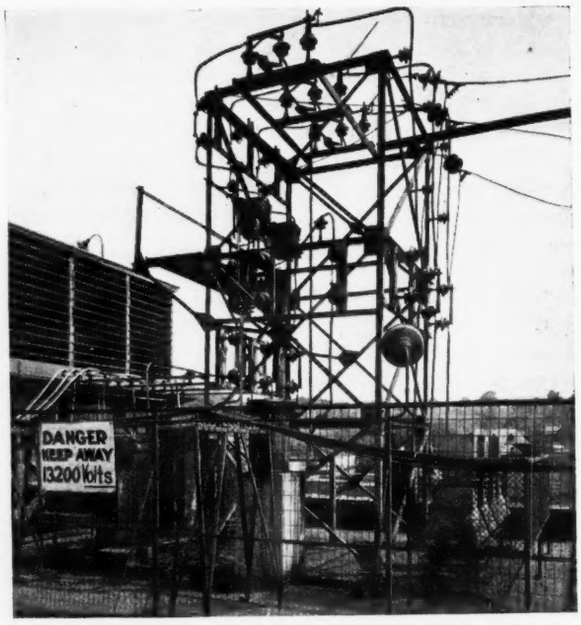
Steam-heated buttermilk-drying rolls use live steam reduced to 60 lb. and are drained by Armstrong traps. All live and exhaust steam for the buttermilk department is metered by Republic steam flowmeters. Steam for factory use and power is not metered separately, the check being made by deduction of buttermilk steam from total steam. Exhaust steam to the buttermilk department is charged to it and credited to the factory and power departments. In June, 329,940 lb. of exhaust went to the buttermilk department, which at 21.6 cents per M is $71.27. This handled 70 batches during 256½ hr. working time.

Due to the large low-pressure heating processes, very little exhaust steam is wasted. A charge of 10% of live steam supplied to the buttermilk department is made to take care of feedwater heating and pumping and fuel-oil heating, pumping and atomizing. This charge is taken care of at the end of the month only. Thus, of the 3,879,000 lb. of steam generated in June, 1,473,750 lb. went directly to buttermilk and 2,405,250 lb. to factory live steam. Adding the 10% allowance as explained, raises buttermilk steam to 1,621,125 lb. and reduces factory steam to 2,257,875 lb., giving respective fuel costs of $350.16 and $488.28. Charging the buttermilk department the $71.27 for exhaust steam increases its steam cost to $421.43 and lowers factory steam cost to $417.01. Oil went 14,882 gal. to the buttermilk department and 24,248 gal. to the factory, or with the 10% adjustment for feedwater and oil heating, etc., 16,370 gal. to buttermilk and 22,760 to factory.

Electric power to operate churns, vans, pumps, wrapping machines, etc., is purchased from the local utility at 13,200 volts, our own transformers being installed on the roof. Power is used at 220 volts, 3-phase, and lights on 220/100 volts, single-phase. We have an "off-peak" contract, whereby an extra charge is made for all current used between 4 p.m. and 7 p.m. during November, December, January and February, very desirable for a plant of our type, because short-day operation is normal during these months. Total power purchased in June was 24,620 kw.-hr., at an average cost of 1.6 cents per kw.-hr. Because we use steam-driven ammonia compressors, our electrical demand is about stationary the year round, the difference being in hours used, which are much fewer in the winter.

Refrigeration

Refrigeration during June averaged about 15 hr. per day. Normally, the engine-driven compressors are fully loaded about 8 hr. per day, four months of the year, which would cause a very high demand charge the year 'round if they were electric driven, and would cause a much higher ultimate cost per kilowatt-hour. The electric-driven refrigerating machine is run only when no steam is needed and the factory is shut down, in order to prevent an extra demand charge because of this unit. This gives this refrigeration for the energy charge only. Heat balance of the plant is such that it is about an even break as to whether electric power is generated or purchased, even at the present low cost. Any additional low-pressure heating load on the plant would make generators pay dividends.



G.E. transformers and Marley spray pond on plant roof

In June, we used 664,500 cu.ft. of water, 390,400 cu.ft. in the buttermilk department and 274,100 cu.ft. for the factory and power departments. It is necessary to subdivide this use both for proper allocation of charges and because we pay for water on a sliding scale, the buttermilk department getting a low rate and the factory and power departments a high rate. Thus, in June, buttermilk-department water cost us $256.83, factory and power water $220.67, a total of $477.50. Water is normally charged equally to the factory and to the steam plant, a charge of $110.34 for one and $110.33 for the other in June.

It is necessary that we keep very close records in order to allocate costs properly. Our procedure is as follows: The electric meter is read weekly and at the end of each month. A daily report shows ammonia condensing pressure, suction pressure, cold-room temperature and time on and off of machinery, together with a meter reading. At the end of the month a consolidated report is made showing all steam, water, fuel, electricity, evaporation, etc. This is filed for reference.

All costs are totalized and calculated per unit of product. When first installed, the plant was operated for several years with only an oil meter, Taylor recording feedwater thermometer, and recording pressure gages for the boilers. Costs of steam was estimated to the departments. Finally, an accurate check was necessary, so three steam flowmeters were installed. We feel that they paid for themselves during the first year of operation. A CO_2 meter was installed at the same time. Feedwater, fuel and atomizing steam to the boilers are hand controlled and this makes the instruments a great help to the operating crew, in that a single glance shows the condition of the fires and steam load so that adjustment can be made accordingly. Normally, we operate engine and boiler room with one man per 8-hr. shift. These same men handle ordinary repairs.

ADVENTURES of a WELDER

By N. L. Rea
Construction Engineering Department, General Electric Company

IN THE DAYS when arc welding was "aborning," a Belfast-trained blacksmith was detailed to the new job, welding, because he knew his metals and was a real workman. He took to the new trade like a duck to water, and had knack and knowledge to develop many of the tricks of the trade that are now standard practice. Withal, he was something of a character and had a rare sense of humor.

Fishing

Once upon a time our welder was sent to demonstrate at a railway convention held on a famous recreation pier. Arc welding was new and there was always a crowd to watch him work. In the midst of a demonstration for some of the "brass hats", he suddenly said "Wait a minute", dropped his electrode holder, stripped off his mask and gloves, stooped over, grabbed a hand line that was tied to his ankle, and, rushing to a nearby window, hauled in a small fish. Rebaiting and dropping his line, he resumed the demonstration. There were enough ardent fishermen in the crowd to enjoy and forgive.

Dahgs

When calls came for help in the new art he was sent as a matter of course, and always had some rare tale to tell on his return. His soft brogue cannot be put into print, but his story of a mid-winter trip into Upper Canada went something like this:

"Shure, but I had a quare time this thrip! Wen I gat av the train there wuz a fella to met me wid a bunch o' dahgs tied to a lang board thing curled up at wan ind.

" 'Fwat is that fer?' sez I.

" 'To rhide un, ye dommed fule', sez he.

" 'An' how do yez rhide ut?' sez I.

" 'Get on an' we'll show yez,' sez he.

"At that I stud up on the board, he hollered ut the dahgs, they jumped forrards and I landed un me hed in the shnow. They they brushed me of, set me an the board, give me some fur mittens (fer I had none) an' we shtarted. We only upset a few toimes afore we reached camp.

"Man, but they wuz gud to me. They tuk me huntin' and we gat a deer. They said they wud give me the skin, but I kudn't get ut home.

" 'Do you give ut me an I'll get ut home,' sez I.

" 'Man, but ye can't do that,' sez they. 'There's a game protector at the junction wid a dahg that shmells of every wan and their baggage, an' he'll git ye shure.'

" 'Lev at to me and I'll fule 'em,' sez I.

"Thin I ripped the linin' o' me overkote at the bottom, caught wan ind of the skin at the collar, sprid ut out and sewed ut fast. Jest befur we reached the junction, I tuk a wee bottle of ammonia from me pockut an sprinkled ut on the bottom o' me coat. Ye shud av seen thut dommed dahg turn up his noze an' go 'way 'round me! But I had a bad scare at the Border. The Customs Inspector picked up me coat where ut lay in the corner of the seat.

" 'Man!' sez he, 'but yu have a heavy coat!'

"But I thot quick and sez, 'Ye need un to keep from freezin' to death in this counthry!'

"Wid that he laffed and passed on."

Getting Home

He arrived in his home town late one night, returning from a job, and decided to walk home. His tools and mask were wrapped in his overalls and tucked under his arm. Near the station he was intrigued by the display of tools in a pawnshop window and stopped to have a look.

"A cop across the street sez, 'Fwat ar ye doin' there?'

" 'Fwat is ut to ye?' sez I.

" 'Come over here,' sez he.

" 'I wul not,' sez I. 'If ye want to talk to me, come over yerself. Yer show leather is no better than mine.'

"With that he come over and tuk me to headquarters. There the sargent asked a lot o' questions, luked at me papers, and sed I kud go home.

"Well, I was near halfway home whin I met another nosey cop, and we has some words. He phoned for the waggen. The sergeant tuk wan luk at me an said, 'G'wan home'.

"Well, I set out wunst more and was near home when I met anither cop. He, too, was nosey and overbearin', so we wint to th' patrol box to phone.

"However, the sargent sed, 'Fwat kind of a lookin' guy is he?'

"The cop gov a rough description o' me, and then the sargent sez, 'Du ye tak thot dommed cuss home! I've had him in here twice the night, an I'm fair sick o' him!' "

DIESEL STEELS

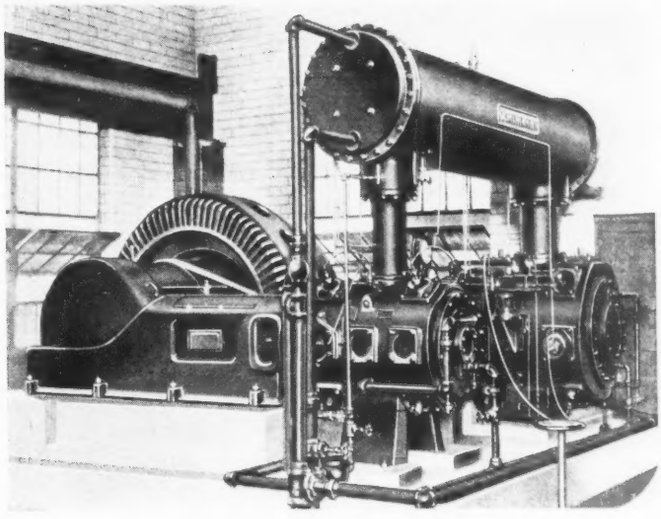
IN A paper, "The Present Position of Special Steels for the Heavy Oil Engine," before the Diesel User's Assn., London, England, on Oct. 12, S. F. Dorey included the table here shown, which, though dealing with British practice, nevertheless is fairly acurate for American diesels as well. It indicates, for both high- and low-speed engine types, just what materials are coming into use to replace the old standard —cast iron. In the absence of any American study of a similar nature it gives much useful information.

Mr. Dorey points out that not only operating conditions, but also cost must be considered in choosing a material, thus while some other material might possibly be superior to a material at present in use for a specified part, the chances are that the superior material is so much more expensive that its use cannot be justified on an economic basis. Thus, for example, Mr. Dorey feels that the additional cost of alloy steels in heavy forgings is not compensated for by the increased life they give.

He also brings out the interesting fact that the method of heat treatment is vitally important in the service which a particular material can give. Thus, carbon tool steel parts must be tempered below certain temperatures, depending on carbon content, to prevent the piece from getting a rough, bright surface which increases the rate of wear instead of decreasing it. Thus, 0.4 carbon steel must be tempered below 200 deg. C., 0.8 below 300 deg. C., and 1.3 below 400 to 500 deg. C.

The complete paper contains an additional table showing exact metal compositions, heat treatments, etc., and gives detailed data on methods on hardening, typical mechanical properties, etc.—principally of interest to designers. Copies may be obtained from the Diesel Engine Users Assn., 56 Victoria St., Westminster, London S. W. 1, England.

	LOW-SPEED ENGINES	HIGH-SPEED ENGINES
CRANKSHAFT	28—32 ton carbon steel. 31—35 ton carbon steel. 32—37 ton carbon steel. 34—38 ton carbon steel. 37—42 ton carbon steel.	32—38 ton carbon steel. 35—41 ton carbon steel. Case-hardened carbon steel. "40" carbon steel. 3—3½% nickel steel. Nickel-chromium steels. Nickel-chromium molybdenum steel Nitriding steels.
WEBS OF BUILT SHAFTS	Rolled slabs as above. Mild steel castings.	50—55 ton carbon steel (0.5% C.). 3½% nickel steel.
CONNECTING RODS	28—32 ton carbon steel. 31—35 ton carbon steel. 32—37 ton carbon steel. "40" carbon steel.	"40" carbon steel. 3—3½% nickel steel. Nickel-chromium steel. Nickel-chromium molybdenum steel
CONNECTING ROD ENDS	As above, or steel castings.	As above.
CONNECTING ROD BOLTS	Special mild steel. 28—32 ton carbon steel. 32—38 ton carbon steel. 2—3% nickel steel. Nickel-chromium Molybdenum steel	3—3½% nickel steel. Nickel-chromium steel. Nickel-chromium molybdenum steel.
PISTON RODS FOR SINGLE ACTING ENGINES	28—32 ton carbon steel. 31—35 ton carbon steel. 32—37 ton carbon steel.	
FUEL PUMP CASING	Generally carbon steel forgings, seldom exceeding 35 tons tensile.	Generally carbon steel forgings, seldom exceeding 35 tons tensile.
CYLINDER HEAD STUDS AND MAIN BEARING BOLTS	Special mild steel.	Manganese molybdenum steel. 3—3½% nickel steel. Nickel-chromium steel. Nickel-chromium molybdenum steel.
PISTON HEAD STUBS	Nickel-chromium steel. Nickel-chromium molybdenum steel.	
PISTON RODS FOR DOUBLE ACTING ENGINES	28—32 ton or 32—38 ton carbon steel forgings with sleeve of pearlitic cast iron or heat-resisting steel	
PISTON HEADS	Pearlitic cast iron. Cast carbon steel. Pearlitic cast iron with chromium steel crowns. S.M. steel forgings. Chromium steel.	Chromium steel. Nickel-chromium steel. Aluminum alloy.
CYLINDER HEADS	Cast iron. Cast carbon steel. Chromium cast steel. Chrome-molybdenum cast steel. Fabricated from S.M. steel plate.	Alloy cast iron. Cast steel.
CYLINDER HEAD VALVES. (1) STARTING-AIR VALVE. (2) AIR INLET VALVE	Stainless steel. 32—37 ton S.M. steel.	Silicon-chromium steel.
(3) EXHAUST VALVE	Pearlitic or alloy cast iron. Silicon-chromium steel. Austenitic chromium nickel tungsten steels.	Silicon-chromium steel. Austenitic chromium nickel tungsten steels.
(4) FUEL VALVES AND ATOMIZERS	Case-hardened mild steel. 3% nickel case-hardened steel. Special tool steels. Austenitic chromium nickel tungsten steels.	Case-hardened mild steel. 3% nickel case-hardened steel. Special tool steels. Austenitic chromium nickel tungsten steels.
(5) SEATS FOR CYLINDER-HEAD VALVES	Pearlitic cast iron. Alloy cast iron.	Alloy cast iron.
CYLINDER LINERS	Pearlitic cast iron. Alloy cast iron.	Alloy cast iron. High carbon (0.7%) forged steel. Nitriding steel.
PISTON RINGS	Pearlitic cast iron. Special cast iron. Scraper rings of tool steel (1% C.).	Special cast iron. Scraper rings of tool steel.
GUDGEON PINS	Case-hardened carbon steel. Special case-hardened carbon steel with nickel content (up to 3%). Nickel-chromium case-hardened steel.	Case-hardened carbon steel. Special case-hardened carbon steel with nickel steel (up to 3%). Nickel-chromium case-hardened steel. Air-hardened nickel chromium steel.
CROSSHEADS	Crucible steel. Forged carbon steel. 3% nickel steel.	
CAMS AND ROLLERS OR FOLLOWERS	Special cast iron. Case-hardened mild steel. Nickel-chromium case-hardened steel. Nickel case-hardened steel. Nitriding steel.	Case-hardened mild steel. Nickel case-hardened steel. Nickel-chromium case-hardened steel. Nitriding steel.
GEARING FOR CAMSHAFT DRIVE	Phosphor bronze. Forged or cast medium carbon steel. Mild steel sprocket wheels and chain drive. Nickel-chromium steel.	0.5—0.6% carbon steel. 3% nickel case-hardened steel. Nickel chromium steel. Chromium-molybdenum steel. 3½% nickel steel (40 tons/in²).
OIL FUEL INJECTION PUMP. (1) PLUNGERS	Case-hardened carbon steel 3% nickel case-hardened steel. Nickel-chromium case-hardened steel. Carbon tool steel. Nitriding steel.	
(2) LINERS	Pearlitic cast iron. Nickel cast iron. Nitriding steel.	
(3) OPERATING GEAR (CAMS, FOLLOWERS, VALVES AND VALVE SEATS)	Case-hardened mild steel. 3% nickel case-hardened steel. Nickel-chromium case-hardened steel. Special tool steel. Nitriding steel.	



2-stage, 2,200-c.f.m., compressor equipped with 5-step control and driven by a synchronous motor

By C. O. Sandstrom

Mechanical Engineer
Los Angeles, Calif.

Unloading Systems for AIR COMPRESSORS

Varying loads create compressor difficulties which are not generally understood. Here are methods used for regulating output of compressors and an explanation of what happens in a cylinder when the suction is throttled

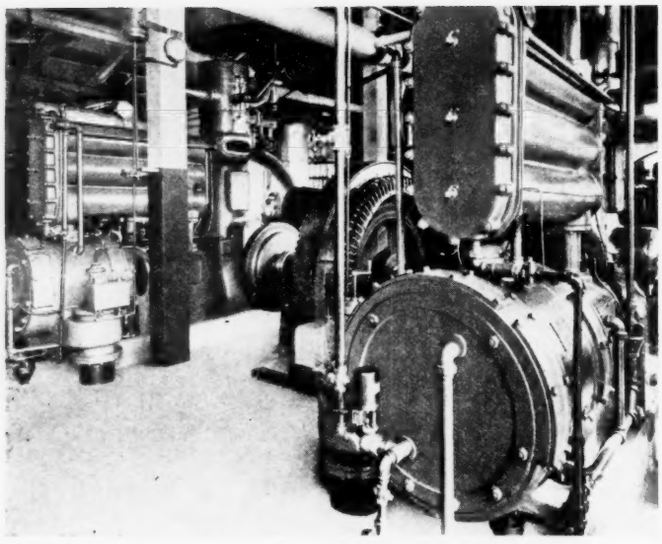
AIR COMPRESSORS are usually driven by constant-speed electric motors; so that when demand for air is also constant, as in air-lift pumping, agitation, aeration and the like, regulation of output is of no moment. But since most compressors supply varying loads, it becomes necessary during periods of light loads to discharge excess air to atmosphere through a relief valve with its consequent loss, or to control the output; one means being "unloading," of which there are several methods.

Difficulties associated with varying loads apparently are not obvious to every one. Several times I have heard of proposals to maintain compressor output constant by simply piping the excess air from a relief-valve on the receiver to apparatus capable of using air whenever it is available. One such proposal was actually in process of being carried out. A relief valve on the receiver of a compressor working under 75 lb. was to be piped to an air-lift pump that used 40 lb. It required considerable patience to show that in order to deliver 40-lb. air to the pump, through a relief valve set for 75 lb., the working pressure in the receiver would have to be 75+40 =115 lb. This would be pretty high for single-stage compression, assuming that there were no other difficulties connected with the proposal.

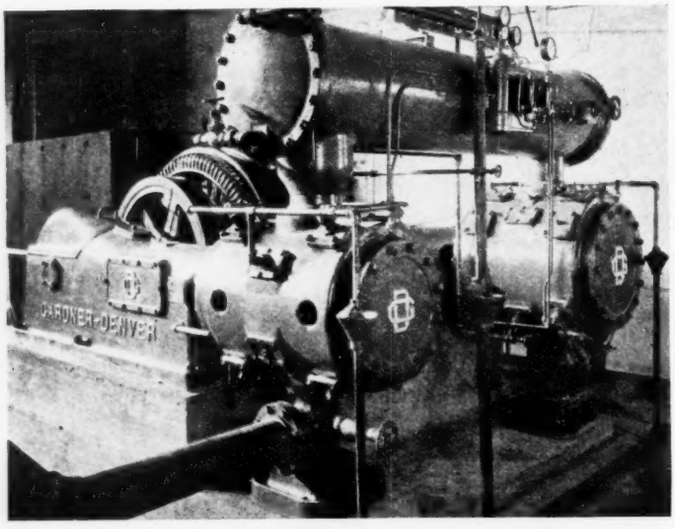
There are probably many places where a portion of the air-using equipment can be isolated for part-time service, to be supplied by the compressor during periods of reduced demand by the principal equipment. But, efforts to divert excess air to practical use, without increasing the working pressure, should be directed to automatic opening of a valve other than a spring-loaded relief valve. For this kind of service a relief-valve functions as a reducing valve, and the working pressure in the receiver must be increased by the amount necessary to hold the valve open.

Every conceivable method of control of air-compressor output has been tried with varying success. Among the methods are: electrical controls that start and stop the compressor automatically; magnetic clutches to stop and start the compressor, but allowing the motor to run continuously; starting and stopping by means of tight-and-loose pulleys as found on machine tools; throttling the suction pipe so that only the required volume of air enters the cylinder; closing the suction valves so that no air enters the cylinder; closing the suction pipe, which, in a few strokes, is equivalent to closing the suction valves; holding open the suction valves and permitting the air to return to the atmosphere without compression; holding open the suction valves in one end of the cylinder and, if the demand is further reduced, holding open the valves in the other end, a method sometimes called 100-50-0% control; holding the discharge valves open and permitting the high-pressure air to pass back and forth between the ends of the cylinder; providing so-called "clearance pockets," which are additions to the clearance space, and which are brought into communication with the cylinder one after another, thereby delaying opening of the suction valves and consequently reducing the volume of the intake air, giving a 100-75-50-25-0% control; combinations of the foregoing methods.

When air compressors are driven by steam engines, their speed may be varied over wide ranges to ad-



Twin angle-compound compressor connected to a synchronous motor by two magnetic clutches to give 100, 50 and 0% output control



An 870-c.f.m., 2-stage compressor driven by a synchronous motor and controlled by 3-step pneumatic unloader pilots

just output to air demands. Today most compressors are driven by squirrel-cage induction or synchronous motors, both of which are constant-speed types. Even when compressors are driven by direct-current motors, the range over which the speed can be controlled is quite limited unless specially designed motors are used. Consequently, the compressor output must be regulated by some other means than speed control. For small compressors and compressors supplying intermittent service, air output is adjusted to demands by starting and stopping the compressor. When the air pressure reaches a predetermined value, a pressure switch functions to stop the motor and then start it again when the pressure drops a specific amount. This method of air control is only satisfactory on small units or where starting and stopping of medium- and large-size compressors is infrequent. Frequent starting of large motors subjects the control equipment to severe service, and, on many power systems, the starting peaks cause objectionable disturbances.

On some power systems, where compressors are driven by synchronous motors, it is desirable to have the motors run continuously to correct power factor. The conditions are sometimes taken care of by connecting the compressor to the motor with a magnetic clutch. The clutch is de-energized by a pressure switch when the air pressure reaches a predetermined limit and energized when the pressure drops to a specified value. With a single compressor, this system of control is equivalent to starting and stopping the motor to regulate the air supply, except that the motor runs continuously.

Magnetic clutches are also used to connect duplex compressors to their motors. For some applications one half of the compressor is coupled to one end of the motor shaft and the other half connected by a magnetic clutch to the other end. This permits operating the unit at either 100 or 50% capacity by energizing or de-energizing the clutch.

For other applications each half of the compressor is connected to the motor with a magnetic clutch. With both clutches closed full-capacity operation obtains. Disengaging one clutch gives 50%, and releasing both clutches 0 capacity. This amounts to a 3-step control, giving 100, 50 and 0% capacity. On a great many compressed-air systems using medium and large-size units, the compressors are allowed to run continuously and their outout controlled by regulating the volume of air entering their cylinders.

Unloading

Controlling the output of compressors by regulating the volume of free air entering the cylinder is called "unloading." In one such method a valve in the suction pipe "throttles" the air to the cylinder, resulting in a cylinderful of air at less than atmospheric pressure and a correspondingly smaller volume of discharge. This, as well as the total closure methods, increases the ratio of compression and, one would think, the discharge temperature. For example, with a suction temperature of 70 deg. F., a discharge pressure of 80 lb. gage, an exponent n of 1.30 derived from the ratio of specific heats, and a pressure of 7.35 lb. abs. in the cylinder at the beginning of the compression stroke—that is, a half cylinderful at atmospheric pressure—calculated final temperature is 496 deg. For a pressure of 3.7 lb. abs. at the beginning of compression, final temperature is 660 deg.

Throttling the suction results in a larger ratio of compression, and apparently a higher discharge temperature. Also, as the incoming air passes through valves, and encounters cylinder walls that are highly heated, actual air temperature at the compression-stroke beginning is higher than is commonly assumed. With the increase of temperature comes an increase of pressure, but the temperature effect may be said to be greater than the pressure effect. If at the beginning of the compression the air is at 3.7 lb. abs. (one-fourth atmosphere), and 70 deg. F., and is heated by the valves and cylinder walls to 100 deg., its pressure is increased thereby to

$$(460+100)\times\frac{3.7}{460+70}=3.91 \text{ lb. abs.}$$

But the temperature at the end of the compression is

$$(460+100)\times\left(\frac{3.91}{80+14.7}\right)^{0.231}=1,169 \text{ deg. abs. or}$$

709 deg. F., a temperature increase of 49 deg. for a

pressure increase of only 0.21 lb. per sq. in. And during a part of the compression period the air absorbs additional heat, thereby increasing its pressure independently of the work of compression.

Even under the highest compression ratio, there is a limit to the temperature attained. Though there is a great increase in the calculated final temperature of air compressed from a low suction pressure, its heat content is comparatively low. Air under the conditions assumed in the foregoing, but entering the cylinder at atmospheric pressure, that is, at 14.7 lb. abs., will have a temperature at the end of compression of 861 deg. abs., or 401 deg. F. Assuming a specific heat of 0.24 B.t.u., the heat added to the air is $1 \times 0.24\ (401-70) = 79.5$ B.t.u. per lb. But with air entering at one-fourth atmosphere and raised to the temperature of 709 deg. F., as in the foregoing, the heat added is $0.25 \times 0.24\ (709-70) = 38.4$ B.t.u. per lb., a little less than half that for atmospheric pressure. Moreover, as the temperature range is more than doubled the heat transfer to the jacket water and radiation also is more than doubled. Obviously, then, as the ratio of compression is increased, the compression approaches isothermal and finally reaches it; that is, there comes a ratio at which the heat of compression is absorebd by the cylinder and the jacket water, and there is no increase of temperature.

A natural extension of the throttling principle is complete closure of the suction valves, or the inlet. In either case the ratio of compression is a maximum since only the air in the clearance space is compressed and recompressed during the interval of closure. Objection is sometimes offered to the total closure method of regulation, it being alleged that repeated compressions of the air produces high temperature.

When air is compressed the work manifests itself by increased temperature of the air as demonstrated in the foregoing. If, now, it is allowed to expand without doing work there is a slight drop in temperature. But if allowed to do work, expanding to its original pressure, there is a return to approximately its original temperature; how closely depending on the amount of heat transfer to or from the cylinder. The action is somewhat like springs in the ends of the cylinder; while one is being compressed the other is being extended, alternately acquiring and giving up energy.

The next article will discuss types of automatic unloaders.

Practical Methods of Increasing CONDENSER-TUBE LIFE

By William Welch, Jr.

Asst. Mech. Engr.
Interborough Rapid Transit Co., New York, N. Y.

CONDENSER tubes represent an investment of approximately a quarter million dollars in many large power stations. Unlike other equipment represented by similar large investments, they often have a relatively short life. Some stations have replaced tubes as frequently as once every three years, while others get fifteen or more years of service. The average life is probably under ten years. They, thus, represent a major item in powerplant maintenance.

Considerable work has been done toward reducing condenser tube failures and increasing the service obtained from them. This has covered a wide field and has comprised improvements in methods of installing and using, as well as improvements in making the tubes. Improved methods of manufacture and reduction of impurities in the metal have largely eliminated failures due to season cracking, pitting, and dezincification.

At present, inlet-end failure probably causes the majority of tube replacements. "Inlet-end corrosion" is probably a combination of many actions taking place at that location. Such actions as impingement attack, oxygen corrosion, electrolytic action, salt-water corrosion, and erosion due to solids in the water, all combined to greater or lesser degree, result in "inlet-end corrosion."

Probably one of the most effective methods to increase the economic life of condenser tubes is the use of streamlined flush-type ferrules for the inlet ends. Better yet is the recent tendency to expand the inlet ends of the tubes into the tube sheet and to bell-mouth the ends. A comparison of these improved methods with the old method of using slotted straight ferrules sticking out about $\frac{3}{4}$ in. from the tube sheet face shows that the hydraulic conditions have been considerably improved. This method of correction tends to reduce impingement attack, and also retards release of entrained air, consequently reducing oxygen corrosion. Three methods of installing condenser tubes are illustrated in Fig. 1.

Improvements to the circulating-water system, such as elimination of air leakage at pump glands and suction-pipe joints, removal of pockets where entrained air might be trapped, and removal of obstructions to the smooth flow of the circulating water, all tend to reduce oxygen corrosion of the tubes. In certain cases, air-removal devices have been installed in the water boxes of condensers with some success.

Protective paints, metal coatings, etc., offer a simple and economical means for increasing tube life. A special paint has been developed for applying to the inlet ends of the tubes. The tubes are

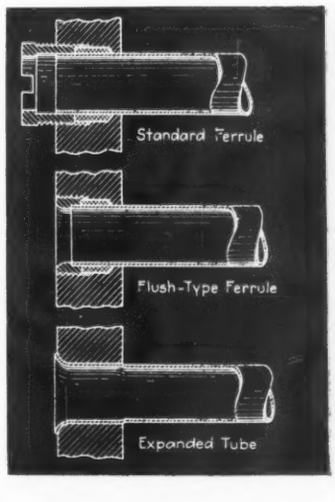


Fig. 1—Methods of installing condenser tubes

coated on the inside for a depth of 6 to 8 in. on the inlet ends. It is evident that, to achieve maximum results from painting, it is necessary to apply fresh coats at intervals frequent enough to maintain a protective film. Usually tubes are painted at intervals of 6 mo. to 1 yr. Other similar devices have been tried; for instance, tinning, metal-plating or spraying the inlet end, or even installing a thin liner of resistant metal. None of these seems to be as effective as paint, probably due to its resilient nature.

Several other methods of increasing effective life have been tried with considerable success. One has been to cut off the defective end and to electric-weld a new section to the tube. This can be done quite successfully and at low cost, and it seems to offer an almost indefinite life for the tube where inlet-end corrosion is the principal cause of failure. Another method is to allow inlet ends to deteriorate a predetermined amount, when the tubes are withdrawn, reversed end for end, and re-inserted. By this means average tube life can be increased about 75% at little cost. It is estimated that one year of additional life will more than pay the cost of withdrawing and reinserting. This latter method can be applied only to tubes installed with ferrules and packed at both ends.

New Alloys

It seems likely that inlet-end failures can be reduced considerably so that life of tubes will depend largely upon the corrosion-resistant properties of tube metal. Admiralty brass has been the commonly accepted standard metal for this service, especially where salt and brackish waters are used for cooling. Several newly developed alloys are available which, although more expensive than Admiralty brass, give distinctly superior service and are frequently economically justified. Among the promising alloys are the cupro-nickels and aluminum brasses.

The new aluminum-brass alloys have the property of building up a dense and hard oxide coating. This so-called "protective film" is resistant to impingement attack and oxygen corrosion. It is also self-healing, so that any puncturing of the film, such as caused by erosion or scratching, is speedily repaired.

In many cases results of tests of new condenser tube alloys are more favorable than actual conditions justify. This is especially the case when tests are conducted by installing a few of the new alloy tubes in a condenser containing Admiralty tubes.

In one such case, 300 new aluminum-brass tubes were installed in a condenser containing approximately 10,000 Admiralty tubes. 300 new Admiralty tubes were installed at the same time. At the end of 5 yr., the Admiralty tubes were worn to a feather edge at the inlet end and many had failed. On the other hand, the aluminum-brass tubes were in excellent condition and only two had failed; those two failures were caused by local pitting due to obstructions in the bore of the tube. The average life of Admiralty in this locality is 8 yr. Brackish water is the circulating medium.

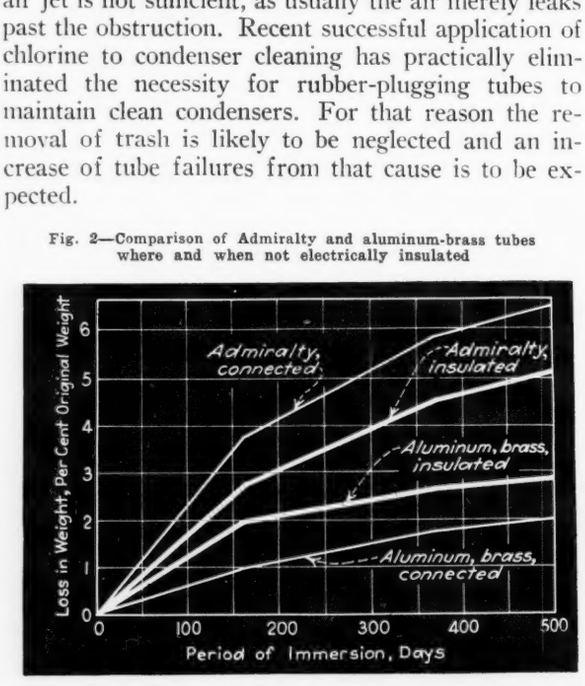
Because of the extreme difference in performance of the two alloys, further tests were decided upon. These tests showed that where salt or brackish water is the circulating medium, voltaic action will be set up between samples of dissimilar metals such as Admiralty and aluminum-brass. Actual measurements show that potentials exist between Admiralty and aluminum-brass, or Admiralty and cupro-nickel of 20 to 30 millivolts, with the Admiralty anodic to the other alloys. The tendency of such voltaic action is to accelerate solution of the Admiralty and to retard solution of the other alloy. Thus when a few sample tubes are installed in a condenser otherwise equipped with Admiralty, the special alloy tubes are likely to be protected at the expense of the Admiralty, and results favor the sample tubes.

Further tests were made to determine the extent of the action. Two short lengths each of Admiralty and aluminum-brass were placed in an insulated holder and spaced the same as tubes in a condenser. A couple was formed by connecting one tube of each metal together at one end. The other two tubes were kept entirely insulated. These samples were then submerged in the circulating-water inlet well over a period of several years. Loss in weight of each tube over this period was carefully obtained, and results are shown on the attached curve, Fig. 2. If the losses in weight of the two insulated samples are accepted as normal for the two alloys under the test conditions, then we see that due to electrolytic action in the connected samples, the loss in weight of the Admiralty tube was greater than normal and the loss in weight of the aluminum-brass less than normal. There is also definite proof that the loss in weight of the aluminum-brass tube under normal conditions is considerably less than that of Admiralty.

We see as a result of these tests that considerable caution must be exercised in accepting test data bearing upon the relative life of different alloys.

In addition to inlet-end failure and general deterioration of the tube metal, another common cause of tube failure is a result of the lodging of some obstruction in the tube. A small piece of cinder or coke, when lodged in a condenser tube, will partially obstruct the flow of water at that point and will set up a local condition of impingement attack and oxygen corrosion. Unless the obstructing material is removed, puncture of the tube usually results in a relatively short time. The remedy, of course, is simple; frequent rodding or blowing rubber plugs through the tubes to remove the trash. A compressed-air jet is not sufficient, as usually the air merely leaks past the obstruction. Recent successful application of chlorine to condenser cleaning has practically eliminated the necessity for rubber-plugging tubes to maintain clean condensers. For that reason the removal of trash is likely to be neglected and an increase of tube failures from that cause is to be expected.

Fig. 2—Comparison of Admiralty and aluminum-brass tubes where and when not electrically insulated



Its Own Medicine

Coal mine generates its power at a saving of $10,000 a year

By F. H. Tathwell

F. H. Tathwell Co., Power Engineers

MANY coal mines in both the East and the West Kentucky fields are purchasing a part or all of their power, and piling up in their yards coal for which there is little or no market.

Development of the domestic stoker has created a good market for a treated pea coal, to produce which the operator is screening out everything below ⅜ in. This leaves a screening for which the market is very limited, so it must be moved out of he way and stored, or sold at $0.50 per ton f.o.b. the mines.

Realizing this, Black Diamond Coal Mining Co., Drakesboro, Ky., in June of last year retained a consulting engineer, and began modernization of its power plant, which consisted of four 2,500-s.ft., 160-lb., Keeler water-tube boilers, one stoker-fired and the other three hand-fired, and a 150-kw., 275-volt generator, direct-connected to a Ball automatic slide-valve engine and two large hoisting engines. The 150-kw. generator produced an average of 20,400 kw.-hr. per month. The rest, an average of 74,550-kw.-hr. per month, was purchased at a flat rate of $0.02 per kw.-hr., thus making an average bill of $1,491 per month.

A used 625-kva. Allis-Chalmers condensing turbo-generator costing $7,500 and a temporary forced-draft system were installed, the latter a temporary measure until boilers can be reset.

Operation of the turbine has increased coal consumption by 4 lb. per kw.-hr. of energy generated. Based on this, monthly coal consumption has increased 149.1 tons, which at 50 cents per ton costs $74.55.

Monthly charges against the turbo-generator are:

Cost of additional coal	$74.55
Average labor	450.00
Interest at 6% on $7,500	37.50
Maintenance and taxes	37.50
Oil, waste and packing	10.00
Total monthly charges	$609.55

The monthly saving is then $1,491.00 — $609.55 or $881.45, which amounts to $10,577.40 a year.

A further saving of coal and oil amounting to about $783 can be made by discontinuing operation of the engine set, making the total possible saving $11,360.40.

POWER FOR A TANNING PLANT

JOHN R. EVANS & COMPANY, leather manufacturers of Camden, N. J., have a factory that sprawls over 20 acres of ground. Electrical power is supplied by three General Electric turbo-generators operating from a bank of eight 150-lb. Bigelow boilers. Originally, all were hand fired. Evaporation averaged about 7 lb. of steam per pound of coal. Tests run with the Detroit Unistokers recently installed on six boilers show that these boilers are now giving about 10½ lb. of steam per pound of coal.

Coal is delivered by barge to a large storage yard on a bank of the Delaware River. From here the fuel is trucked over the plant's property to a smaller storage space in the boiler house.

The two 750-kw. turbo-generators are each equipped with a Wheeler condenser, which operates at 27-in. vacuum. These units give a desirable flexibility in case of machine failure or shutdown for repairs or overhauling as slightly overloaded, one unit can generally carry the 800 to 1,000-kw. normal load of the plant.

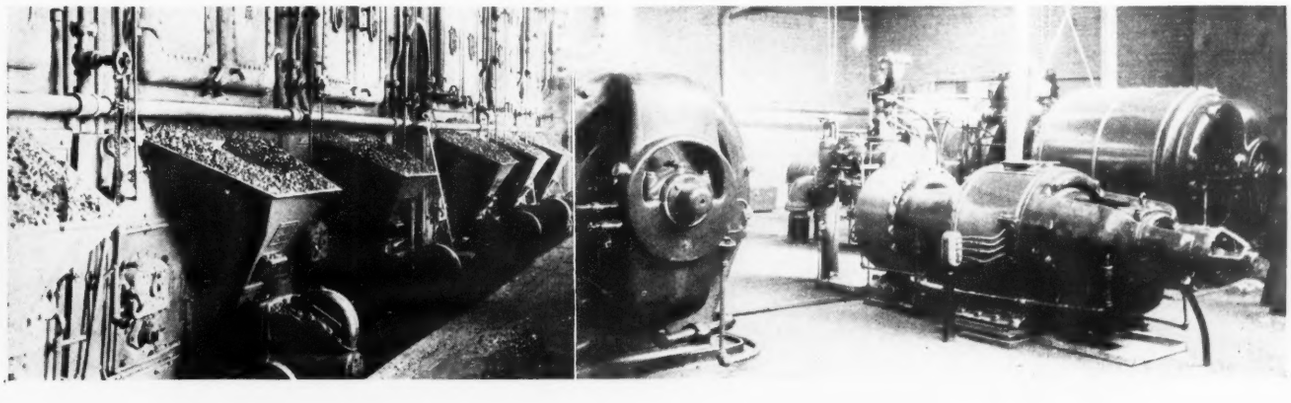
Condenser cooling water is pumped from the Delaware River. It leaves the condensers at about 98 deg. and is pumped into the plant for tanning processes. In addition, each turbine is equipped with bleeder mechanism that takes off 4-lb. steam for process work in the factory.

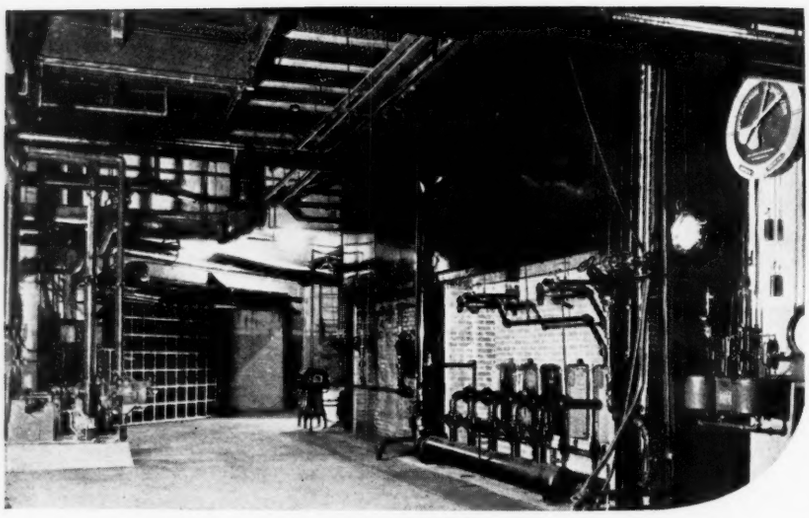
The third turbo-generator is a 100-kw. non-condensing unit for standby and light emergency use.

Each generator delivers 60-cycle, 3-phase a.c. at 440 volts. The main switchboard controls and synchronizes these units, as well as distributes power to the three feeders supplying substations scattered around the plant. Each feeder is controlled by an oil circuit breaker. Emergency feeders are also provided. All plant motors operate at 440 volts.

Each feeder circuit is metered so that accurate power costs can be determined for the three departments. This simplified distribution system has also greatly facilitated the location of line faults, and reduced the maintenance problem to one-man-per-department simplicity.

Two 750-kw. and a 100-kw. turbo-generators comprise the power-generating equipment. Left—Six of the eight boilers are stoker fired, increasing evaporation from 7 to 10½ lb. of steam per pound of coal





Gas burners installed at rear of boiler. Combustion control at right

Palmer House Summer

By J. B. Nealey
American Gas Association

IN CHICAGO a new rate makes it cheapest to use gas under boilers in summer. Many concerns are taking advantage of this rate and putting in gas burners for April-October use.

A gas conversion was made at the Palmer House, where the power plant includes four 6,450-sq.ft. boilers. While it requires three boilers to supply hotel requirements during the winter, only one is necessary during seven summer months. Therefore, only one boiler was converted. This unit has shown considerable savings. Steam-fuel costs with gas averaged $0.276 per 1,000 lb. of water evaporated over a 6-mo. period, as contrasted with steam costs with coal of $0.33.

Furthermore, this single boiler produced 50,600 lb. of steam per hr., with gas and a stack temperature of only 440 deg., while with coal only 44,850 lb. per hr. were evaporated, and stack temperature was 570 deg. An efficiency of 72% was obtained with gas with 10.5% CO_2.

A straight water-tube longitudinal-drum boiler was converted. First, the coal stoker and partial Dutch oven were removed and the baffling changed. It was decided to fire with gas from the rear. The furnace setting consisted of 9-in. firebrick, 9-in. temperature-insulating brick and 2 in. of mineral wool.

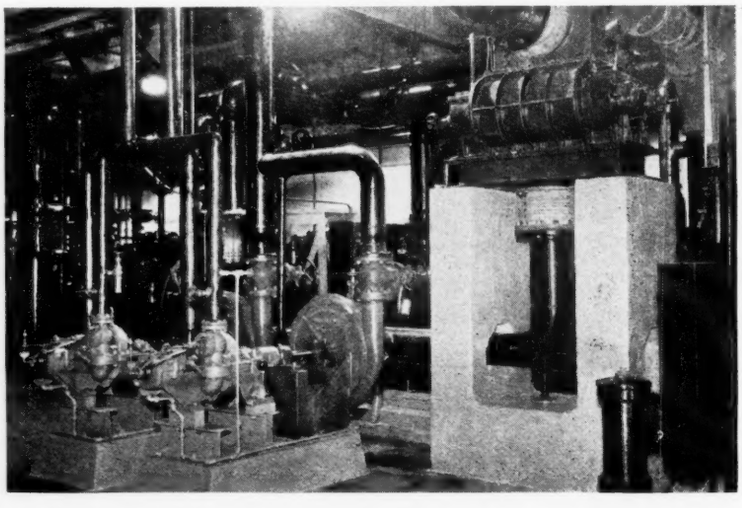
Five entrained-combustion type gas burners were installed, thus providing wide flexibility to meet the exacting thermal requirements. These burners developed maximum output of the boiler at slightly under 12-oz. pressure. This burner is of the multi-unit, multi-jet type wherein gas velocity assists in entraining the necessary air to support ignition of the gas. Gas is introduced from a series of jets in each port at a predetermined angle into the incoming solid core of air. In this manner all air entering the furnace is compelled to mix with the gas streams, thus contributing to a rapid ignition rate and completing combustion within a short distance of the burner face. Gas is introduced through 76 angular spuds into 40 units in each burner.

Using gas in the summer caused oil fuel to assume importance for winter use, because the winter base load can be carried on the coal-fired boilers and swings taken on the oil-fired boiler. This operating procedure improves over-all efficiency because the efficiency curve of a gas or oil-fired boiler is comparatively flat over a wide range of load, while that of a coal-fired boiler (natural draft, chain grates) is flat over a narrow range. With this in mind, combination gas and oil burners were installed, oil being used in winter only.

A 12-in. gas main was run from the street level down to the boiler-room in the sub-basement. Here the line is connected to a meter receiving the gas from the city distribution system at approximately 4-in. water pressure. The outlet side of the meter is connected by 10-in. pipe to two turbine-driven compressors which boost gas pressure from 4 in. to the required 12 oz. Exhaust steam from the turbines is used to heat water. From the booster 8-in. pipe runs to a cross header at the rear of the boiler, from which 3-in. drops, properly valved with lubricated-plug cocks, are connected with each burner unit. A raw-gas pilot light is supplied with each burner unit. Service-pipe capacity is 90,000 cu.ft. of gas per hr.

The Hagan automatic control system consists of

Booster compressors increase gas pressure to 12 oz.



Gas Fires Boiler

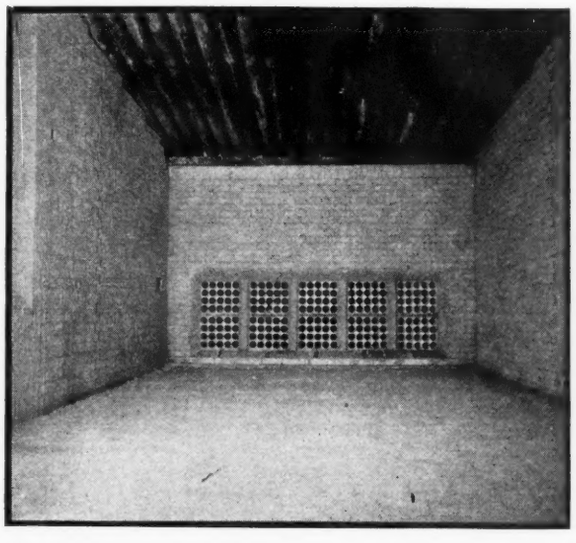
Low April-October rate makes change economical. Oil used in winter, when this unit takes load fluctuations

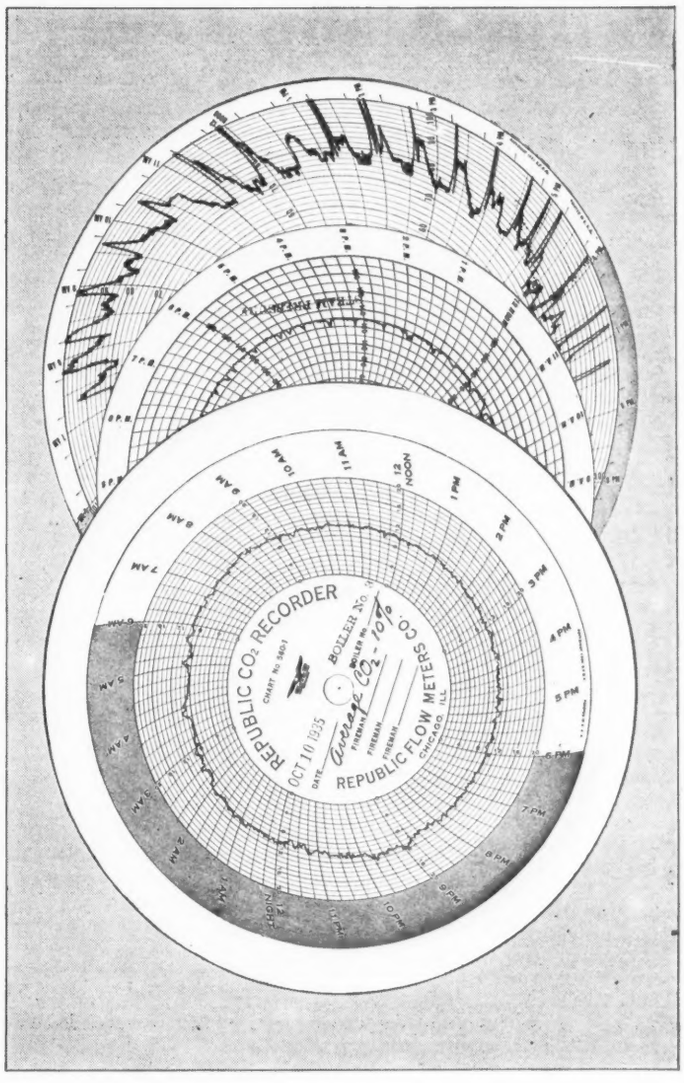
a gas valve actuated from the steam pressure, and a stack damper actuated from gas pressure and furnace draft. The regulator is fully compensated and responds immediately to small changes in header pressure. This sensitive response insures close regulation of fuel supply in step with steam demand.

Control of air for combustion is accomplished with an assembly of draft controller (sometimes called float machine), and gas-pressure-actuated leak-off valve. This draft regulator adjusts the uptake damper to maintain correct furnace suction in ratio to the gas supply to each burner. The system is designed to insure a constant gas-air ratio over the full range of operation, as well as to compensate automatically for changes in gas pressure or in the available stack draft. The changes in no way effect the efficiency of the system, because the uptake-draft regulator immediately readjusts the damper until the correct amount of air is drawn in for the gas being burned.

Due to the high furnace temperatures and the large amount of radiant heat reflected on the lower row of tubes, a clean boiler internally is imperative. This was accomplished by careful attention to feedwater treatment, thereby eliminating all scale inside tubes. Furnace temperature is higher with gas than with coal because excess air is reduced and the volume of radiant heat increased. Excess-air elimination also

The gas burners from the furnace side





Steam flow, steam pressure and CO_2 charts after 5-mo. operation

helps reduce stack temperature. Flue-gas temperature with gas fuel is only 85 deg. above the steam temperature when the boiler is operating at 200% rating. More boiler-tube surface is subjected to a greater volume of radiant heat with gas than with coal, thus requires less convected heat to evaporate the same amount of water.

In analyzing the economic feasibility of changing from coal to gas, decreased brickwork maintenance and stoker repairs are important items. Experience at the Palmer House indicates that these are practically eliminated with the adoption of gas. Slag and ash impingement from coal-burning lowers the melting point of the brickwork.

Three charts are shown: (1) steam flow, (2) steam pressure, and (3) CO_2 content. The converted boiler was fired May 15, 1935, for the first time, and the charts selected are dated Oct. 10, 1935. These show operating conditions when the steam demand was large. They indicate the accuracy and ease with which gas can be controlled under all load conditions, maintaining high efficiencies under widely fluctuating loads as evidenced by the CO_2 line.

Tailor-Made Feed System for Dependable Water

By W. Harry Archer

Consulting and Industrial Engineer, San Francisco, Calif.

Mr. Archer starts with the specification for dependable boiler water, and proceeds, step by step, through the design of a feed heating and treating system to produce this result. This is a practical article based on actual experience

THE SYSTEM to be described combines well-known and well-proved elements, but the arrangement is novel in some respects. It is in successful operation in a typical industrial plant of moderate size, and pressure.

All engineers agree that boiler heating surfaces should be clean and in good condition, that there should be a continuous supply of non-corrosive water at uniformly high temperature. They agree that blowdown should strike a happy medium between waste of water and heat on one hand, and excessive concentrations on the other. But it is another thing to attain these objectives.

The typical plant to which this system will apply generates part or all of its own power, and uses exhaust steam at about 5 lb. for heating, drying or process. The raw water can be economically softened by zeolites. Please note, however, that this plan should not be adopted for all installations of this type without study. It is emphatically true that the heating and treating system must be adjusted to suit the character of the water, steam pressure, steam application, kind and size of boilers.

Here are the objectives:

1. Water treated so it will not form scale.
2. Water deaerated and otherwise treated so that neither dissolved oxygen nor other chemicals will cause corrosion.
3. Feedwater of such chemical characteristics that minimum blowdown is required.
4. Feedwater with chemical relations maintained to prevent caustic embrittlement.
5. Feedwater free, or practically free, from "patent medicines" or cure-all compounds.
6. Feedwater at a uniformly high temperature.
7. Blowdown of boilers to maintain proper concentration, preferably with recovery of most of the heat of the blowdown.

Fig. 1 shows raw water flowing through a zeolite softener and being used as makeup to supplement returned condensate, the amount being controlled by a float valve in the makeup tank or hot well. A filter ahead of the softener represents good practice and is essential with some kinds of water. In any case, it relieves the softener of the filtering job and simplifies backwashing.

Fig. 1 also indicates an automatic feeder for sulphuric acid added to the makeup water softening to maintain the A.S.M.E. sulphate-carbonate ratios. These are 1-1 for boiler pressures up to 150 lb., 2-1 for pressures 150 lb. to 250 lb., 3-1 for pressures over 250 lb.

Generally, sulphuric acid is the most economical way to add sulphate. However, sodium sulphate is easier to handle and may be used economically where the quantity required is small.

The mixture of condensate and softened makeup is then passed through a deaerating heating process to an insulated hot-water storage tank. The system of deaeration and storage illustrated in Fig. 2 has several noteworthy points. The storage is large to provide ample capacity during regeneration of zeolite and during feedwater emergencies. Because of this large storage, and because the level is usually kept at the full point, arrangements are made for normal withdrawal of the water close to the surface, where the temperature is high. This reduces tank radiation losses. When it is necessary to use the storage volume, water is withdrawn from the lower outlet, which is opened by a float-controlled, free-swinging butterfly valve. Under some conditions the same results could be obtained by an internal swinging pipe.

Because of its simplicity the particular type of heater shown is not of maximum effectiveness as a deaerator, but if built large enough to raise the water to the maximum temperature, freely vented and equipped with a vent condenser, it gives very satisfactory results.

The illustrated method of mounting the heating element in the tank eliminates many parts and complications otherwise necessary where a complete deaerating heater is installed separately from the storage tank. Remember also that even the best deaerators do not give complete deaeration under conditions of operation

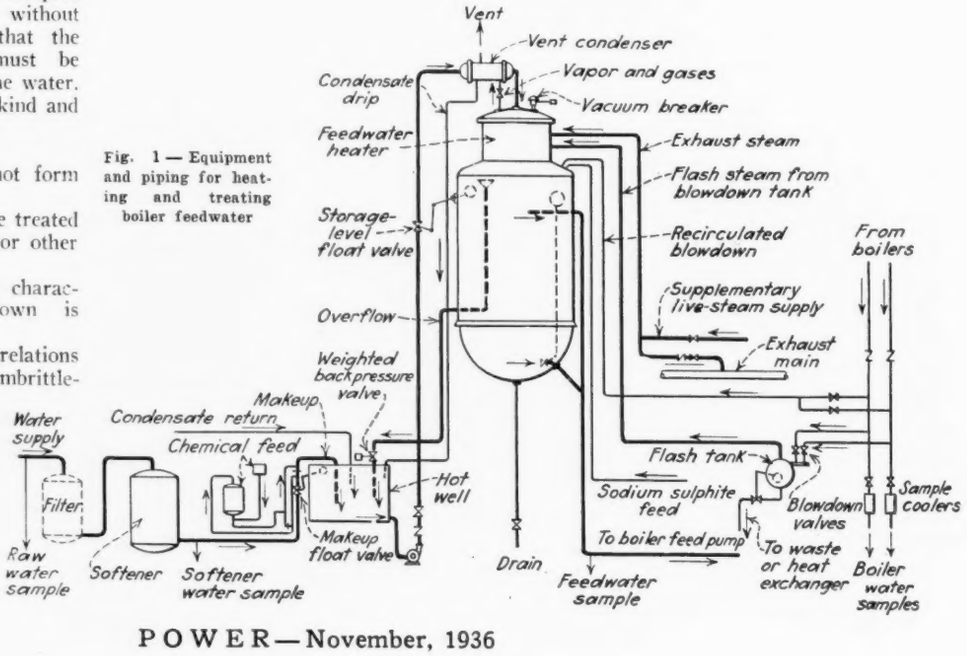


Fig. 1 — Equipment and piping for heating and treating boiler feedwater

here indicated and therefore need to be supplemented, for 100% results, by a slight chemical treatment.

To remove the last trace of oxygen, one can feed sodium sulphite to the storage tank. This chemical is cheap, the quantities required are small, and (sulphite changing to sulphate) helps maintain the sulphate-carbonate ratio. Articles in June and July, 1935, *Power*, by Sheppard T. Powell, thoroughly describe such chemical deaeration.

The storage tank is subjected to the pressure of the heating steam. This steam atmosphere above the stored water prevents it from reabsorbing air. Gases removed (oxygen, nitrogen and carbon-dioxide) pass off through the vent condenser, together with enough steam to insure complete removal. Vented heat is transferred to incoming feedwater. These portions of the circuit through which the vented gases and condensation pass should be cast iron, copper or other non-corrosive material. Condensation from the vent condensers should be returned to the hot-well, as indicated.

Often there will be ample exhaust steam to maintain deaerating conditions continuously. But if it falls short, even for a few moments (as will be indicated by the recording thermometer), enough live steam must be supplied to keep heater pressure slightly above atmospheric and thus insure outward flow through the vent. This use of live steam is not extravagant, because the heat so drawn from the boilers is returned to them again in the feedwater, with the exception of a little radiation.

The small amount of sulphuric acid added to the makeup water is not enough to make the mixtures aggressively corrosive, but the pH value is probably slightly on the acid side. Diversion of some boiler blowdown water into the feedwater storage tank (see Fig. 1) neutralizes this slight acidity with the alkalinity in the boiler blowdown. Even with intermittent blowdown, the same result can be attained by returning a small amount of boiler water to the storage tank.

A small but noteworthy feature (Fig. 2) is the shallow container immediately below the feedwater-heating element. In this is mounted the recording-thermometer bulb, to measure continuously and reliably the temperature of water leaving the heater.

Another point of interest is the combination overflow and excess-pressure release on this storage tank. An effective overflow is essential to prevent water reserve backing up into the exhaust-steam supply. At the same time the overflow must be such that it will not permit an undue escape of steam.

A weighted back-pressure valve keeps the overflow closed until a predetermined pressure develops, either due to steam pressure or to an accumulated head of water in the overflow pipe. 2. During normal operation there is enough condensation in the overflow pipe to fill it periodically and therefore cause the valve to open until the pipe is empty. This periodic operation prevents valve sticking. For successful operation of this kind of overflow, the variation in steam pressure must not be excessive in relation to the hydraulic head acting at time of overflow. Otherwise it will be impossible to secure a satisfactory setting of the backpressure valve.

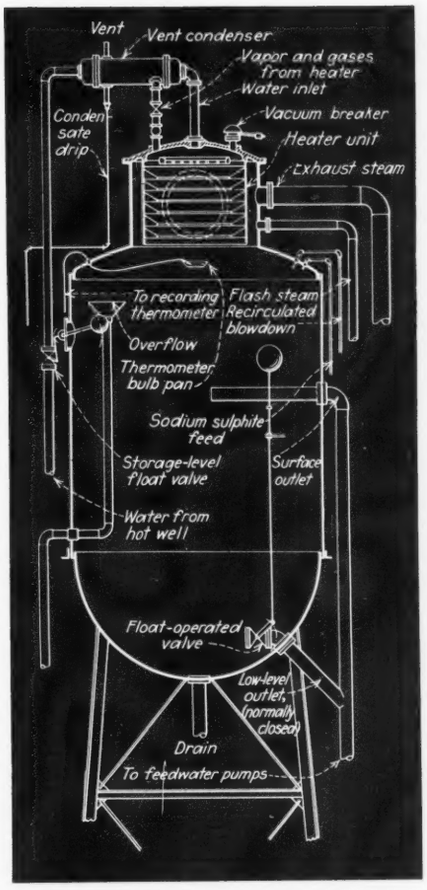


Fig. 2—Feedwater heater and storage tank

The vacuum breaker admits air if a destructive vacuum threatens. It is important to place the storage tank high enough to provide a sufficient head on the boiler feed pump.

Continuous blowdown has many advantages. Too much complication should, however, be avoided in a plant of this type. The principle benefits can be obtained by the simple system indicated. This consists of connections to each boiler through which the water can be removed from the desired point in the upper water drum and the flow controlled by suitable high-quality, hand-regulated valves. Water so removed at high pressure and temperature is passed into a flash tank which, in this case, is under the same pressure as the feedwater storage tank (5 lb.). Temperature of the blowdown immediately drops to that corresponding to 5 lb. pressure. The flashed steam passes over to the feedwater heater. Remaining heat in the blowdown can be recovered by a heat exchanger, but the economy of this further step is generally questionable.

Coolers for test samples of blowdown water are essential. Samples drawn without cooling are not truly representative, because an appreciable percentage flashes into steam, increasing the concentration of the liquid remainder.

Tests and Observations

The amount and rate of blowdown is controlled in accordance with periodic tests of concentration and alkalinity. It is economical to keep blowdown as low as possible. This amount varies with different kinds of boilers and different operating conditions. Only experience will show the proper value.

Periodic tests of the feedwater in the storage tank will reveal:

1. Methyl orange alkalinity as a measure of carbonate for determining the sulphate-carbonate ratio; 2—The sulphates to determine whether sulphuric feed is correct; 3—An excess of sodium sulphite to complete deaeration; 4—The pH to show whether the acid has been properly neutralized and the prescribed conditions reached by an addition of alkaline blowdown.

Soap tests at the water softener will show if the effluent has been completely softened. Soap, pH, and alkalinity tests of the raw water should occasionally be made also, especially if the water source is subject to frequent variations.

Tests for checking conditions at various steps are simple and can be performed quickly by any operator after a short period of instruction and practice. Test equipment is standardized and inexpensive. A proper form for tabulating results provides records for the firemen, for the plant superintendent, and for future reference. Other data, including quantities, meter readings, and temperatures, can readily be checked on the same form, or the tests can be incorporated in the regular boiler room log.

It is hard to describe a system of this sort plainly and at the same time show how simple it really is. This simplicity exists not only in the equipment and its arrangement, but also in the operation. Required operating adjustments are less frequent than with a plant not equipped with the refinements shown. Float-controlled levels, high feedwater temperatures automatically maintained, and clean boilers all contribute to its smoothness of operation and the minimum of attention and maintenance. Resulting economies, not to mention the savings of fuel and water, will readily justify the cost.

Power to Process

OUR TENTH special section, scheduled for December *Power*, will be a unique contribution to the needs of power engineers in industry. Thirty-six pages, in three colors, will present the fundamentals of power-service applications to processes of all kinds. Divisions will include basic services, basic operations, basic process equipment, heat transfer, meters, controls, traps, connections, cost systems, typical service consumptions, and a detailed example of a complete process hookup. This section, we believe, will be of outstanding practical value, enabling power and process engineers to speak the same language when they meet for cooperative action at the point of service application.

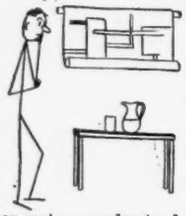
Speaking of Power

canny engineers

With cold weather coming on, it's time to think about "degree-days," if you haven't already. This yardstick of heating performance is manna from heaven for the engineer who wants to prove his ability to save money. Without it he is on the defensive in cold weather and fails to get proper credit for real savings made in mild seasons. . . . Anything that changes the weather from an argument to arithmetic is worth while. That is why many canny engineers, particularly in buildings and institutions, are now reporting their heating steam (or coal) "per thousand cubic feet of heated space per degree-day."

Business keeps on picking up month after month. Of the many manufacturers I have talked to in recent weeks, I have yet to find one who doesn't admit he is busy and getting busier. What they say is confirmed by walks through their factories; I see plenty of work in process.

"Enthalpy" (pronounced "enTHALPy") wins official recognition. The executive committee of the Council of the A.S.M.E. has voted to accept a committee report recommending that the terms "total heat," "heat content" and "heat of the liquid" be abolished as misleading and be replaced by "enthalpy," a word already widely preferred by thermodynamic specialists. But some will shy at the new word as something dark and obscure. Many a writer, addressing a practical engineering audience, will face this dilemma: "Shall I be precisely correct in my language or shall I be understood?" Some will prefer to be understood.



correct or understandable?

Last month I went out to Cleveland to talk on hospital power plants at the convention of the American Hospital Association. Taking a chance on brick bats, I hinted that the hospital plants are probably as bad as the average of American industrials and institutions, wasting perhaps 50 cents out of every power dollar. . . . After the talk one of the mechanical supervisors told me that I had understated conditions. He had surveyed hospital plants in the East as well as the Midwest and found evaporations which ranged from 9 lb. water per pound of coal down to 3 lb. The highest power-service cost per patient was 9 times the lowest. . . . My hunch is that the MDs have been too busy with medical matters to give the mechanical end a real break. Whether this is true or not, it is certain that the hospitals have wasted millions of power dollars. . . . My professional prescription for such a condition is "get a doctor," in this case a trained power engineer.

. . . . get a doctor

On the way back from Cleveland, I stopped off in Rochester, N. Y., to visit with Bill Gessner, power engineer of the Taylor Instrument Companies. He showed me his new "week-end" boiler that is paying 100% yearly on the investment (see page 631), also an air-compressor conversion that saved junking an old machine. This operation will be described in a future number. . . . As I go around from plant to plant I am more and more impressed with the fact that there is always a way to save some more money if the engineer keeps his eyes open and management cooperates.

Going up in the hotel elevator in Cleveland a young lady got panicky at the idea of being the last to get off. Thought it was some sort of ill omen, asked the operator just what might happen to her. . . . That's the modern world for you—all full of the finest mechanical gadgets scientific ingenuity can devise, used daily by millions of people who still hold to the superstitions of the dark ages. . . . Even more peculiar was the request of a young couple an engineering friend and I encountered at the brink of Niagara Falls. It was night and the colored flood lights were on. "How long do you look at the Falls," the husband asked. "What's that?" "How long are you supposed to look at the Falls?" We told them to look until they got tired of it, for which information they thanked us very politely. Apparently they wanted to do the correct thing, whatever that might be.

. . how long a look?

A while back I gave vent, on this page, to some thoughts on the future of high-speed steam engines. A manufacturer writes in that he is nearly ready to market a unit of from 20 to 50 hp.

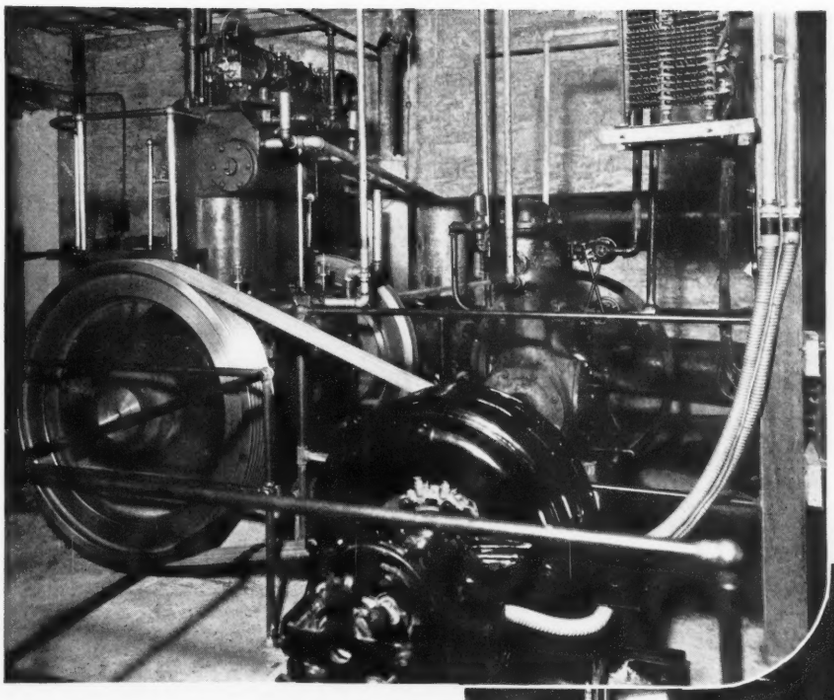
It will be a semi-uniflow, high-speed engine, single-acting, multi-cylinder, with poppet valves. Steam pressures are middling (300 to 500 lb.) but temperatures range from 500 to 900 F. I am told that little or no cylinder lubrication will be used.

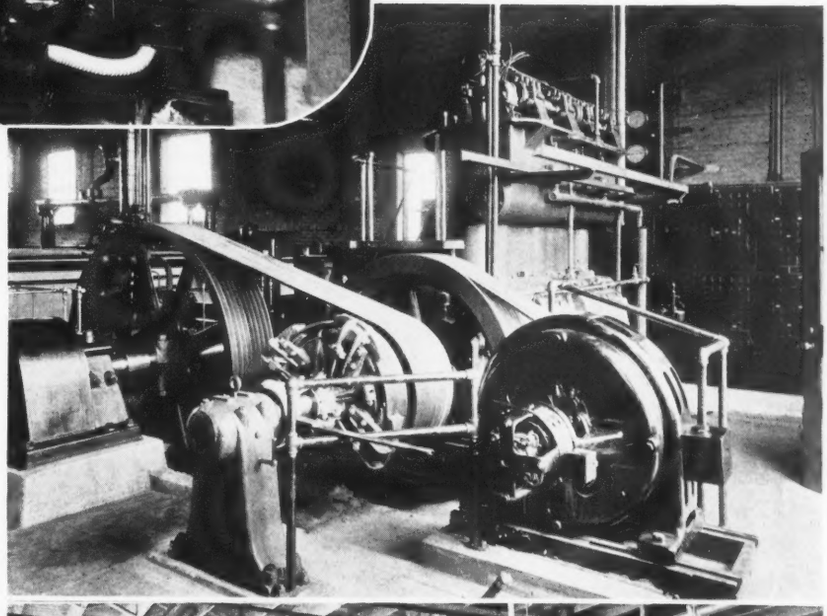
On a recent trip to the G.E. plant in Schenectady I saw lots of things of moderate interest and some of extreme interest. Practically all of the latter were labeled "not for publication." Of moderate interest, because you probably suspect it anyway, is the fact that business is picking up very rapidly in practically all electrical and associated lines. Of extreme interest are some of the latest achievements of the G.E. research and engineering labs. On these my mouth is officially sealed, but I suppose no one will shoot me if I throw out the hint that these laboratories, like those in certain other large industrials, have developed new materials and products of sensational qualities. They will contribute enormously to higher living standards in the years immediately ahead.

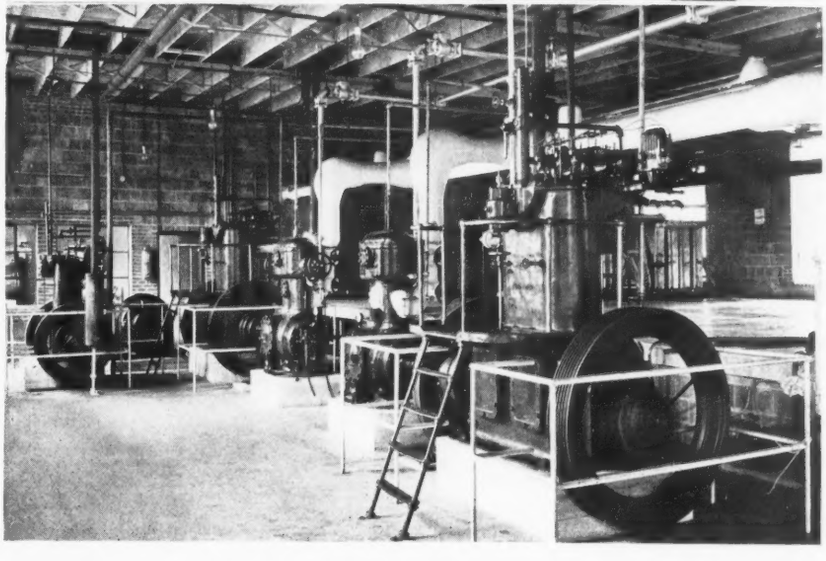
PHIL SWAIN
Editor

New Prime Movers on Old Equipment

Sometimes, in modernization, it pays to hook a new prime mover to an old driven machine. But—wisdom demands a look to the future







▶ Seymour Packing Co., Winfield, Kan., had a 44-kva. alternator, a 6½ x 6½-in. York ammonia compressor and a 20-g.p.m. pump. A 65-hp. gas engine was V-belted to all three, driving the alternator on one side, the compressor on the other, and the pump from the engine flywheel

▶ Morris Ice Co., Jackson, Miss., had a 94-kva. Ideal alternator and a 9½ x 18-in. horizontal, duplex, double-acting, Vilter compressor. Two 200-hp. gas engines were installed, arranged right-and left-hand, each with an extension shaft and outboard bearing with a Hill clutch. Drive can be from either engine through Allis-Chalmers V-belts

▶ Independent Ice & Refrigerating Co., Tulsa, Okla., has a 40-hp. gas engine driving a 42-kva. alternator, a 65-hp. engine driving the same alternator from one end and an 8 x 8-in. Frick ammonia compressor from the other, and another 65-hp. engine driving an 8 x 8-in. Frick compressor only. But the opposite flywheel is V-grooved to handle any future load.

Photographs courtesy The Bruce-MacBeth Engine Co.

Let's Get Down to FUNDAMENTALS

PATERNAL ANCESTOR

ONCE UPON A TIME there was a little Steam Trap that ventured forth into Topsy Turvey land to find a place to live. But when he got there, other steam traps told him, "You'll never do here. You have too many moving parts. Your fittings are all wrong. You are too simple. And besides that, your ears are too long!"

Perplexed, the little Steam Trap returned from Topsy Turvey land and went direct to Great-great-great-grandad Steam Trap. "Sire," said he, addressing the venerable one, "Aspersions have been cast upon my ability to whistle like a peanut vendor's wagon. Pray please tell me again: just what is it that I'm supposed to do?"
Here is what the old boy told him:

I

A TRAP MUST DISCHARGE WATER

a. The orifice should be large enough to take care of peak loads easily regardless of the operating pressure.

b. The trap should be able to handle condensate at any temperature—cold, warm, or at steam temperature.

c. Actual condensate capacity ratings are necessary. Calculated capacities or cold water tests are of no value. Armstrong's capacity table shows what Armstrong traps will handle when the condensate is at steam temperature.

II

TRAPS SHOULD PREVENT LOSS OF STEAM

a. When the Armstrong bucket is 2/3 full of steam it floats and closes the valve.

MAKING PERFECT CONTACT WITH SEAT

b. The Armstrong valve will close tight in any position because it is a perfect hemisphere and always makes a perfect contact with its seat.

c. The Armstrong valve will continue to make perfect closure because both valve and seat are made from heat-treated chrome steel that is very hard and tough.

d. The Armstrong Trap does not require adjustment in order to function properly.

e. The Armstrong Trap will discharge condensate to, but hold steam against, the highest vacuum obtainable.

III

A TRAP SHOULD BE ABLE TO DISCHARGE AIR

a. In the Armstrong Trap, air escapes through the vent in the inverted bucket. This vent is always open to handle air at any temperature.

VENT OPEN

b. Large vents, thermostatically controlled, can be furnished for Armstrong Traps to drain jacketed kettles, syphon-drained rolls, etc. These large air vents can be adjusted to close at any required temperature.

THE ARMSTRONG TRAP PRIMER

IV

A TRAP SHOULD BE ABLE TO OPERATE UNDER BAD WATER CONDITIONS

a. Any oil present with the condensate will rise to the top of the Armstrong trap body and be discharged first.

b. There are no dead spots in the Armstrong trap body in which dirt or sludge can settle.

DEAD SPOTS

c. At very little extra cost, all parts in an Armstrong Trap can be furnished in stainless steel which will resist acid or alkali as may be required.

V

A TRAP SHOULD REQUIRE LITTLE MAINTENANCE

a. The Armstrong Trap has only two moving parts —the bucket and the lever assembly. There are no pivots or cotter keys.

FRICTION-LESS OPERATION

b. Frictionless operation insures long life of parts in an Armstrong Trap. There are no sliding contacts or variable clearances to affect the power of the bucket to open the valve.

c. The Armstrong valve opens wide and closes tight. This prevents wire-drawing and scoring of valve.

d. There are no parts that can be damaged by excessive pressure.

VI

A TRAP SHOULD BE EASY TO USE

a. The Armstrong Trap is light in weight and small in size—particularly on the basis of capacity.

b. The position of connections fits in well with standard practice and permits simple installations regardless of what the requirements may be.

c. Each trap is equipped with a handy test plug over the discharge orifice.

TEST PLUG

d. Care is taken to prepare literature that answers every possible question a user might have about the application or installation of Armstrong traps.

VII

A TRAP SHOULD HAVE RESPONSIBLE BACKING

a. The success of the Armstrong organization depends entirely on the performance of the Armstrong Trap. Under such circumstances, it is only natural that great care is excercised to make sure that every customer is satisfied and that every claim is fulfilled.

EXERCISING CARE

b. Armstrong representatives subscribe whole-heartedly to Armstrong policies. Many of them have built their business entirely on the success of Armstrong Traps.

c. The Armstrong guarantee of "Complete Satisfaction" means just that!

P.S. Points listed here are discussed in detail in the new Armstrong Steam Trap Book. If you would like to read this book, drop us a line and we will send you a copy.

ARMSTRONG MACHINE WORKS
812 Maple Street — Three Rivers, Michigan

© POWER

Pump Suction Heads With Hot Water

Table I — Recommended Minimum Pressure at Pump Suction

Temperature of water, deg. F.	Velocity at pump suction nozzle, ft. per sec. 6		7		8		9		10		11		12		13		14		15	
	Additional head, ft.	Pressure, at pump, lb. per sq. in abs.	Additional head, ft.	Pressure, at pump, lb. per sq. in abs.	Additional head, ft.	Pressure, at pump, lb. per sq. in. abs.	Additional head, ft.	Pressure, at pump, lb. per sq. in abs.	Additional head, ft.	Pressure, at pump, lb. per sq. in abs.	Additional head, ft.	Pressure, at pump, lb. per sq. in abs.	Additional head, ft.	Pressure, at pump, lb. per sq. in abs.	Additional head, ft.	Pressure, at pump, lb. per sq. in abs.	Additional head, ft.	Pressure, at pump, lb. per sq. in abs.	Additional head, ft.	Pressure, at pump, lb. per sq. in abs.
190													0.0	14.7	2.0	15.5	4.2	16.4	6.4	17.4
200							0.3	14.8	1.5	15.3	3.0	16.0	5.0	16.7	7.1	17.6	9.4	18.6	11.7	19.6
210	2.6	15.8	3.1	16.0	3.8	16.2	14.7	16.6	6.1	17.2	8.0	18.0	10.0	18.8	12.2	19.8	14.6	20.7	17.0	22.0
220	4.7	19.2	5.2	19.4	5.8	19.6	6.8	20.1	8.2	20.7	10.0	21.4	12.0	22.2	14.2	23.2	16.5	24.1	18.9	25.1
230	6.1	23.4	6.7	23.7	7.3	23.9	8.3	24.3	9.8	24.9	11.6	25.7	13.7	26.5	16.0	27.5	18.3	28.4	20.7	29.4
240	7.8	28.3	8.4	28.5	9.0	25.8	10.0	29.2	11.4	29.8	13.3	30.6	15.4	31.4	17.6	32.4	20.0	33.3	22.5	34.4
250	9.7	33.7	10.2	33.9	10.9	34.2	11.8	34.5	13.2	35.1	15.1	35.9	17.2	36.7	19.4	37.6	21.7	38.4	24.2	39.5
260	11.4	40.0	12.0	40.2	12.6	40.5	13.6	40.9	15.0	41.4	16.9	42.2	19.0	43.0	21.2	43.9	23.6	44.9	26.0	45.8
270	13.6	47.4	14.1	47.6	14.7	47.8	15.7	48.2	17.1	48.8	19.0	49.5	21.0	50.3	23.2	51.2	25.5	52.1	27.8	53.0
280	15.6	55.4	16.0	55.6	16.7	55.9	17.6	56.2	19.1	56.9	21.0	57.6	23.0	58.4	25.3	59.3	27.6	60.2	30.0	61.2
290	18.2	64.9	18.7	65.1	19.4	65.4	20.3	65.7	21.8	66.3	23.6	67.0	25.7	67.9	27.9	68.7	30.2	69.7	32.5	70.6
300	20.4	75.2	21.0	75.4	21.6	75.6	22.6	76.0	24.0	76.6	25.9	77.4	28.0	78.2	30.2	79.1	32.5	80.0	35.0	81.0
310	24.2	87.4	24.8	87.6	25.4	87.9	26.4	88.3	27.8	88.8	29.7	89.6	31.8	90.4	34.0	91.3	36.4	92.2	38.8	93.2
320	27.4	100.6	28.0	100.8	28.6	101.0	29.6	101.4	31.0	102.0	32.8	102.7	35.0	103.6	37.2	104.5	39.6	105.4	42.0	106.2
330	32.5	115.6	33.6	115.8	33.0	116.1	34.6	116.4	36.0	117.0	37.9	117.7	40.0	118.7	42.2	119.6	44.6	120.6	47.0	121.5
340	37.2	132.4	37.8	132.7	38.5	133.0	39.4	133.3	40.9	134.1	42.8	134.9	45.0	135.7	47.2	136.6	49.5	137.5	52.0	138.5
350	42.3	150.9	42.9	151.1	43.6	151.4	44.5	151.7	46.0	152.1	47.9	153.1	50.0	153.9	52.2	154.7	54.6	155.6	57.0	156.6
360	46.8	171.0	47.4	171.3	48.0	171.5	48.9	171.9	50.2	172.3	52.0	173.0	54.0	173.8	56.3	174.6	58.5	175.5	60.7	176.4
370	51.3	193.1	51.9	193.3	52.6	193.6	53.5	193.9	55.0	194.5	56.8	195.2	59.0	196.0	61.2	196.9	63.5	197.8	66.0	198.7
380	56.2	211.8	56.8	212.1	57.5	212.3	58.4	212.7	59.9	213.2	61.8	218.9	63.9	219.7	66.1	220.6	68.4	221.5	70.8	222.3
390	61.2	243.3	61.8	243.6	62.5	243.8	63.4	244.2	64.9	244.7	66.8	245.4	69.0	226.3	71.2	227.1	73.6	248.0	76.0	248.9
400	66.2	271.6	66.8	271.8	67.5	272.1	68.4	272.4	69.9	273.0	71.7	273.7	74.0	274.5	76.1	275.3	78.5	276.1	80.8	277.1

Table II — Recommended Maximum Suction Lift

Temperature of water, deg. F.	Velocity at Pump Suction Nozzle, ft. per sec. 6		7		8		9		10		11		12		13		14		15	
	Suction lift, ft.	Pressure, pump inlet, lb. sq. in. abs.	Suction lift, ft.	Pressure, pump inlet, lb. sq. in. abs.	Suction lift, ft.	Pressure, pump inlet, lb. sq. in. abs.	Suction lift, ft.	Pressure, pump inlet, lb. sq. in. abs.	Suction lift, ft.	Pressure, pump inlet, lb. per sq. in. abs.	Suction lift, ft.	Pressure, pump inlet, lb. per sq. in. abs.	Suction lift, ft.	Pressure, pump inlet, lb. per sq. in. abs.	Suction lift, ft.	Pressure, pump inlet, lb. per sq. in. abs.	Suction lift, ft.	Pressure, pump inlet, lb. per sq. in. abs.	Suction lift, ft.	Pressure, pump inlet, lb. per sq. in. abs.
60	23.8	4.3	23.4	4.5	23.2	4.6	22.8	4.8	22.5	4.5	22.0	5.1	21.5	5.3	21.0	5.6	20.3	5.9	19.4	...
70	23.2	4.6	23.0	4.7	22.7	4.8	22.4	5.0	22.0	5.1	21.5	5.3	21.0	5.6	20.5	5.8	19.8	6.1	18.7	6.6
80	22.8	4.8	22.5	4.9	22.3	5.0	22.0	5.1	21.5	5.3	21.0	5.6	20.5	5.8	20.0	6.0	19.2	6.4	18.0	6.9
90	22.4	5.0	22.1	5.1	21.8	5.2	21.5	5.3	21.0	5.6	20.5	5.8	20.0	6.0	19.4	6.3	18.5	6.7	17.2	7.3
100	22.0	5.2	21.7	5.3	21.4	5.4	21.0	5.6	20.6	5.8	20.0	6.0	19.5	6.3	18.9	6.5	18.0	6.9	16.5	7.6
110	21.5	5.5	21.2	5.6	20.9	5.7	20.6	5.9	20.1	6.1	19.5	6.3	19.0	6.6	18.3	6.8	17.1	7.2	15.6	8.0
120	20.8	5.8	20.5	5.9	20.1	6.1	19.6	6.3	19.1	6.5	18.6	6.8	18.0	7.0	17.2	7.3	15.9	7.9	14.3	8.6
130	20.0	6.2	19.6	6.4	19.2	6.6	18.7	6.8	18.2	7.0	17.6	7.3	17.0	7.5	16.0	7.9	14.6	8.5	12.8	9.3
140	18.8	6.7	18.4	6.9	18.0	7.1	17.5	7.3	17.0	7.5	16.4	7.8	15.6	8.1	14.4	8.6	12.8	9.3	10.8	10.1
150	17.6	7.3	17.2	7.4	16.7	7.6	16.2	7.8	15.6	8.1	15.0	8.3	14.0	8.8	12.6	9.4	10.7	10.2	8.7	11.0
155	16.8	7.6	16.4	7.8	15.9	8.0	15.3	8.2	14.8	8.4	14.1	8.7	13.0	9.2	11.5	9.8	9.5	10.7	7.5	11.6
160	16.0	8.0	15.6	8.1	15.1	8.3	14.6	8.5	14.0	8.8	13.2	9.1	12.0	9.6	10.4	10.3	8.4	11.2	6.4	12.0
165	14.6	8.5	14.1	8.8	13.6	9.0	13.0	9.2	12.4	9.5	11.6	9.8	10.2	10.4	8.5	11.2	6.4	12.0	4.3	12.9
170	13.1	9.2	12.7	9.3	12.2	9.6	11.6	9.8	11.0	10.1	10.0	10.5	8.5	11.2	6.7	11.9	4.6	12.8	2.4	13.7
175	11.4	9.9	11.0	10.1	10.5	10.3	10.0	10.5	9.3	10.8	8.2	11.2	6.6	12.0	4.7	12.3	2.7	13.6	0.6	14.3
180	10.3	10.4	9.8	10.7	9.2	10.9	8.7	11.1	7.9	11.5	6.7	11.9	5.0	12.6	3.0	13.5	0.9	14.4		
185	8.1	11.4	7.6	11.6	7.1	11.8	6.5	12.0	5.6	12.4	4.2	13.0	2.5	13.7	0.5	14.6				
190	5.8	12.3	5.3	12.5	4.8	12.7	4.1	13.0	3.2	13.4	1.8	14.0								
195	4.0	13.1	3.4	13.4	2.9	13.5	2.2	13.8	1.0	14.4										
200	1.6	14.1	1.0	14.4	0.5	14.6														

BOILER feed-pumps and heater drain-pumps are required to handle hot water. To secure good operation, the pressure at the pump suction must be enough above the saturation pressure corresponding to the water temperature to prevent steam binding. This additional head is shown in Table I, together with the recommended absolute pressure at the suction nozzle for various velocities and water temperatures. The absolute pressure given is equal to saturation pressure, plus the pressure corresponding to the additional head shown for the temperature and velocity conditions. When, for example, the water in a heater is at saturation pressure, the additional head values in Table I are the minimum elevation of the heater above the pump, which should be increased by pipe friction loss. These heads provide a pressure corresponding to a temperature 10 deg. higher than the temperature of the water handled by the pump.

The height a pump will lift water is limited by the temperature of the water. The recommended maximum lifts for various water temperatures and inlet velocities are shown in Table II, together with absolute pressure at the pump suction. Suction lifts given neglect pipe and fitting friction. Absolute pressures are based on 30-in. barometric pressure.

Civil Engineers Discuss Power Problems

A symposium on technical advances, production costs and economic and social aspects of power generation featured two sessions of the fall meeting of the American Society of Civil Engineers at Pittsburgh

ECONOMIC aspects of power generation, flood control, stream pollution and structural applications of steel and light-weight alloys were among the subjects discussed at the fall meeting of the American Society of Civil Engineers, held in the William Penn Hotel, Pittsburgh, Pa., Oct. 13-16. Social and political aspects of the power problem have been emphasized in recent years. It was with the conviction that no solution of the problem can be found which does not rest on sound engineering and economic principles that the symposium on economic aspects of power generation was sponsored by the power and engineering-economics and finance divisions of the Society. The status of the technical advance in generation and utilization was presented in three papers, followed by analysis in the cost of generation and a discussion of the economic and social aspects of the problem.

Steam Power

The first paper, "Progress in the Generation of Energy by Heat Engines," by George A. Orrok, painted a picture of advancements made in power generation by utilization of heat. Mr. Orrok showed how power-producing machinery in this country had increased in 40 years from 17,000,000 hp. in 1896 to 1,230,816,000 hp. in 1936. Of the stationary power plants of all kinds, 56,684,000 hp. are in steam plants, and 16,000,000 hp. in water-power plants.

When discussing the increase in thermal efficiency, Mr. Orrok pointed out that in 1882 Mr. Edison considered 10 lb. of coal per kw.-hr. a very good record for the first central station. Today Port Washington is reporting a kilowatt-hour over an 8-mo. period for an expenditure of 0.86 lb. of 13,000-B.t.u. coal, an over-all thermal efficiency of 30.6%. The cost of central stations has varied very little since Mr. Edison built Pearl St. station in New York City. "My own records," said Mr. Orrok, "cover more than 150 plants, the cost of which I have in more or less detail. The average cost of these plants from 1882 to date is substantially $100 per kw. of capacity. Dean A. A. Potter of Purdue quotes figures for 80 plants built since 1920, which average $108 per kw. of capacity, while L. W. W. Morrow, of *Electrical World*, quotes 16 plants built since 1927 which average $114 per kw. installed. The average of the 250 plants, with possibly some duplicates and including large and small plants, high- and low-pressure, power and railway, with a small proportion of industrial plants, is about $103 per kw. of installed capacity. In this list the lowest cost is about $60 per kilowatt, while the highest cost plant is around $225 per kw."

Central stations using steam are now in operation giving yearly economies, coal burned per kilowatt-hour sent out, as low as 11,000 B.t.u. per kw.-hr., a thermal efficiency of 31%, as indicated in the table from Mr. Orrok's paper. By taking full advantage of high pressure and temperature, the carrying out regenerating to the limit, and the use of at least one reheating stage, the thermal efficiency might be brought up to about 37%, or to about 9,200 B.t.u. per kw.-hr. Mercury-vapor cycles lead also to around this figure as the ultimate. These plants would be complicated in design and difficult of operation, as well as costly. They would demand much better materials than are now available and are not even contemplated at the present time. But a steam plant running at 10,000 B.t.u. per kw.-hr. may be looked upon as appearing in the near future.

Mr. Orrok closed his paper by expressing the opinion that none of the proposals for new sources of power meet the criterion of a commercial power plant which must generate power when wanted, as wanted and at a cost of little less than what it can be generated for today. He said engineers, scientists and inventors are looking for a new source of power, convenient, plentiful and cheap but until that source appears it is certain that a major part of our power will be generated in heat engines using steam as the heat medium.

Water Power

Water-power's place in power generation was presented by Frank H. Rogers in a paper, "Hydro Generation of Energy." Mr. Rogers showed that from 1900, when the Niagara development were undertaken, there was a rapid increase in installed capacity of waterwheels to 1922, at the rate of about 300,000 hp. per year, when the slope of the curve rises to a still higher value of about 800,000 hp. a year, from 1922 to 1931. In the last four years, however, the increase in installed capacity has fallen off greatly, during the year 1935 being only about 100,000 hp. For the present year, however, a great increase has occurred. About 1,500,000 hp. are being installed, of which possibly 800,000 will actually go into operation.

The size of power units has increased, until now the Boulder Dam turbines being installed, rated at 115,000 hp., are the most powerful units in the world. Great advancement has been made in the last fifteen years in the development of the high-speed propeller-type turbine. An increase in specific speed from about 90 for the francis-type runner to 150 and higher for the propeller-type permit economic development of large low-head installations, due primarily to lower cost of higher speed generators and the reduction in power-house superstructure cost.

An important factor in the advancements in turbine design and operation is the research carried out by turbine manufacturers in their laboratories. Models are constructed, having runners usually 16 in. in diameter, exactly homologous to the large units, including intake, casing and draft tube, and tested over a wide range in power and speed. Changes can readily be made in the runners, guide vanes, casing and draft tubes to obtain the best possible combinations, before construction of the large unit. From the test data secured in the laboratories the performance of the large units in the field can be accurately predicted by well-known stepped-up formulas.

In the last ten years there have been many mechanical improvements in waterwheel design, among which Mr. Rogers

GAIN IN THERMAL EFFICIENCY FROM NEWCOMEN ENGINE

(1770 to Present Perfected Mercury-Vapor Plant)

Year	Prime Mover	Press., Lb. Abs.	Temp. Deg.F.	Eff. of Carnot Cycle, %	B.T.U. Per Kw.-Hr.	Thermal Eff., %
1770	Newcomen Engine	15	212	2.70	416,000	0.82
1810	Watt's Engine	30	300	9.17	61,000	5.60
1900	Nordberg Engine	215	400	20.80	19,200	17.75
1922	Turbine	265	650	35.00	18,000	19.00
1935	Port Washington, eight Months	1,245	825	58.00	11,166	30.60
1935	Port Washington, single Month	1,245	825	58.00	10,850	31.50
1935	Mercury Vapor	140	950	61.00	10,500	32.50
	Mercury Vapor, projected	240	1,025	63.50	9,500	36.00

machining of propeller-type turbine blade surfaces; an adjustable-blade turbine the runner blades of which are automatically adjusted by water flowing to the turbine; and automatic valves to admit air to the turbine at reduced loads.

Speaking of possible future developments, Mr. Rogers said that the demand for reserve-power and peak-power service, particularly in large load centers in the last few years, has resulted in many studies being made of pump-back storage projects. It is believed that some of these projects will materialize in the near future, requiring special turbine and pump equipment to meet the requirements. For this service, two model pump-turbine units comprising in one unit the pumping and generating operations have been designed and tested that gave a maximum efficiency of 87% when pumping and 89% when generating.

Improvements

After reviewing the changes that had taken place in the use of electrical energy, Joel D. Justin, in, "Improvements in the Utilization of Energy," said that technical improvements have permitted decreasing prices. Decreased prices have led to new and wider uses. Increased production has put a premium on further technical improvements, which in turn have permitted further decreases in prices. In this manner the endless chain has operated to the benefit of the power consumer and producer alike.

In the development of the modern power system Mr. Justin enumerated three steps. First, community power companies, regional power companies, and then interconnected systems. Because there is often a diversity in load in several systems that are interconnected, the combined load is less than the sum of peaks of individual systems; it is not necessary to use so much capacity to supply the load; the load reserve capacity required is usually considerably less than would be necessary by individual companies if they were not interconnected; and capital expenditures required are usually less than would be necessary without interconnection.

With interconnection the base load of the combined system is materially increased, and gives opportunity to allocate the most efficiency steam plants to the combined system to or near the base of the load where they will be able to generate a much greater number of kilowatt-hours per year than was possible without interconnection. Where several systems are interconnected, and some of them are served largely by steam plants and others by hydro-electric plants, it is possible to obtain material annual savings by better use of hydro-electric energy.

The supply of energy for the peak load of any power system is always very expensive as compared to the average cost of electric energy. Hydro plants which have large storage available are particularly suited for performing peak-load service required by power systems. Hydro plants, with reasonably high head, and having considerable reserve capacity, located on small streams, are frequently well suited as peak-load plants. Run-of-river plants, having ample pondage, are also often used for peak-load service during seasons of the year when the stream flow is low. The pumped-storage plant is simply a special case of the peak-load hydro plant. In Europe there are at least 40 plants of this type in successful operation, but in this country there is so far only one. Mr. Justin expressed the opinion that there are many situations in this country where plants of this type might be useful in decreasing the total cost of peak-load service.

Power Cost

In "Cost of Generation of Energy," Philip Sporn emphasized that generating cost is only a small part of the total for supplying electrical energy to ultimate consumers. The cost of electric service, to which more and more technical and political-economic discussion is being given, is out of focus because this fact is not realized. More particularly is this point neglected in much of the current discussion on the cost of generation of hydro power by governmental agencies. Hydro-electric power, said Mr. Sporn, is not necessarily cheap power and in most cases is not competitive with steam power.

After giving a very comprehensive analysis of present generation, transmission and distribution costs of power, Mr. Sporn discussed the future cost of power. From his analysis of present costs he draws the conclusion that it is to be expected that one of the most effective fields in which to work to reduce generation costs would be in the investment required. The trend in generating-equipment costs has been downward, even though the slope of the curve has not been very steep. Mr. Sporn, sees, however, a very definite promise in the direction of using higher temperature steam and higher speed machines.

Installation of larger steam units is seen as offering material opportunities for reducing power costs in the future, as is also superposition in existing steam plants. It was pointed out that superposition must be handled in fairly large blocks for the most economical investment.

Mr. Sporn sees nothing on the horizon that would make future hydro developments more attractive economically than those already developed. If anything the natural trend will be for less economical developments, because the most economical sites have been developed. In transmission and distribution there is nothing definite to indicate that new developments will result in rapid progress toward cost reduction. The economic development of future generation requirements of the country, he said, seem to be in the direction of steam plants located at reasonable distances from load centers in reasonably large units with interconnected transmission as a medium of integrating and combining small loads for efficient units of generation and for reinforcing and backing up among neighboring systems.

The economic aspects of energy generation were presented by Ralph A. Freeman and B. A. Thresher. In the minds of many people in this country the productive capacity of an economic machine driven by cheap power has raised some terrifying possibilities. They fear a chronic condition of glut due to ability of markets to absorb the increased output. They claim the old economic problem was how to produce enough; the new one is how to dispose of what we can produce. In the opinion of Mr. Freeman this dread of superabundance is groundless and the scientists and engineers engaged in raising the efficiency of our power machine need not be disturbed.

Mr. Thresher expressed the opinion that progress of the power industry is not dependent upon winds of political change as many would have us think. Behind the surface controversy over forms of organization and regulation lie the real determinants of the problem: the technical limitations of economic production on one hand, and the social and industrial nature of demand on the other.

EXHAUST LINES

By E. J. Tangerman

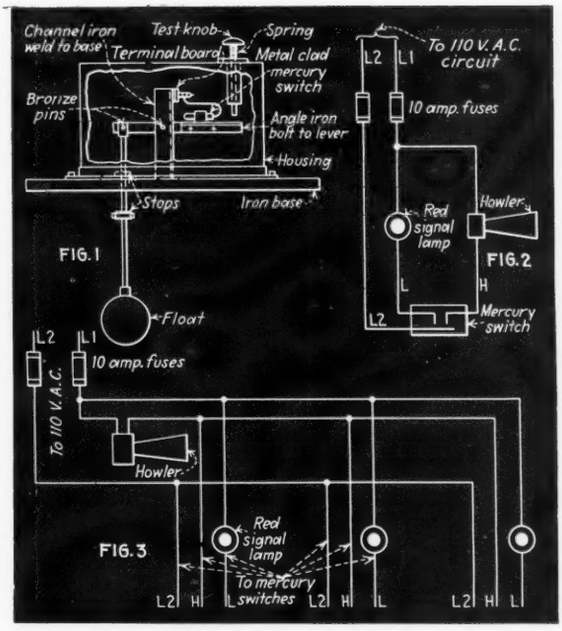
Benjamin Franklin never patented any of his inventions—quite a contrast to some modern inventors who try to get the patent before they have the invention.

Down in Tulsa, I asked E. A. Wooden, chief engineer of Sinclair Prairie Oil Co., if there were any oil fields nearby. "Oh yes," sezzee, "Just down southwest of town here." "Can I walk it?" sez I. "In a day or so," sezzee, "It's only 35 miles!"

Also down in Tulsa, R. K. Lane, vice-president in charge of production and operation for Oklahoma Public Service Co., gave me an interesting explanation of the two types of air conditioning—for temporary and for permanent occupancy. He explained that many of the early installations in stores were designed to provide a cold blast of air for the entering customer, to create in his mind a grateful feeling of comfort, but that such a system is hard on employees who must be in an abnormally chilled atmosphere all the time. Even the customer begins to notice it too, if he stays in the store a while. (That happened to me in a highly touted dining room in a Southwestern hotel—slow service made my dinner take 1½ hr., and in that time I caught a peach of a cold). The other, and more desirable type of conditioning is for permanent occupancy—not so noticeable when you walk in, but not so noticeable either when you walk out, and a darn sight easier on employees.

Reuter Seed Co., New Orleans, La., found that seeds stored in an air-conditioned room maintained a much higher state of germination, so has just doubled its seed-storage capacity.

PRACTICAL AIDS TO OPERATION



Mercury Switches Operate High-Water Alarms

In an industrial plant, a number of electric motors are located in pits below the drainage level. These pits are drained periodically by manual operation of siphons or ejectors. Frequent inspections are necessary to prevent submerging these motors.

In order to decrease the number of inspections, float-operated mercury switches have been installed and arranged to light a lamp and sound a howler when the water rises to a certain level. Small 3-wire switches are suited for operation by slow-moving floats. The switch and its operating mechanism, Fig. 1, are enclosed in a substantial metal housing. A test knob with spring return is provided for daily testing of the switch unit.

Figs. 2 and 3 indicate the electrical connections. For an insolated pit a howler and lamp are employed but for a group of pits, a lamp and common howler are utilized. All wiring is enclosed in conduit and connections are made to a constantly energized source.

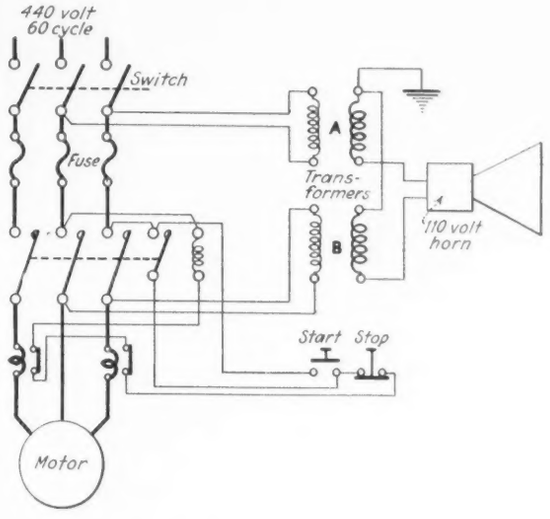
Oakland, Calif. R. B. Glenn

Warning Signals for Motor Shut-Downs

Plant electricians are often called upon to install a device for sounding an alarm, when a motor stops. Practically all standard noise-producing devices are designed for 115 volts, and the motors operate on 440 or 220 volts. The signal device must therefore be supplied with power from another circuit or by a small transformer connected to the power lines. An auxiliary switch to make contact when the starter opens, must be added to the starter, which is frequently not feasible. This method also has the disadvantage of bringing two bare circuits of different voltage in close proximity in the same box. If the lighting circuit is used for signal power, a switch must be added for cutting out the signal when a shutdown occurs.

When the motor starter has a disconnecting device between it and the power supply, automatic signalling can be had with two 100-watt or small transformers and a 110-volt, 60-cycle horn or bell. As shown in the diagram, primary leads of one transformer are connected to the power switch, and on the other transformer they are connected to the starter. Secondaries are connected in series so that their voltages oppose, and the horn or bell is connected to the two remaining leads.

When the motor switch is closed, preparatory to starting the motor, transformer *A* is energized and the horn sounds. The instant the motor starting switch closes, transformer *B* is also energized, its polarity opposes the secondary voltage of *A* and the horn ceases to blow until the starter is again opened. To prevent



continuous signalling after a shutdown, the starter disconnecting switch is opened, which should be done anyway.

This signal system has the advantages of reasonably low cost, infallibility of operation, and absence of contact-making devices. We have had a number of these signals scattered about our plant for the past two years, without requiring maintenance.

Corpus Christi, Tex. John Bolton

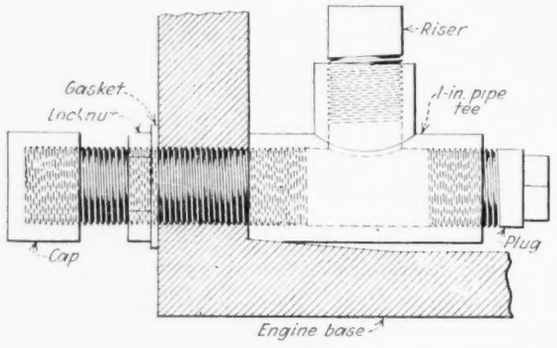
Safeguarding Engine Oil Drainage

In a crude-oil pumping plant the 4-cyl., vertical, 400-hp. diesel engines were pressure-lubricated, the crankcase base serving as sump for collecting the oil and returning it to the circulating pump. Under existing conditions, this oil was drained from the engine every 15 days and replaced with another full charge of 40 gal. During the 15-day period no lubricant was added, unless the level dropped below a predetermined minimum. To save shutdown and drainage time, it was decided that the oil be drained off while the unit was in operation, being charged with make-up oil the instant the last of

the old ran out. The oil drain was fitted with a 1-in. plug which could be pulled to permit the drain line running to the reclaim tanks to be connected.

Draining off the oil required considerable time, and as the shift engineer had many other duties, it was inevitable that occasionally oil draining would be started and forgotten, with the danger of damage to the bearings. To prevent this, the engineer installed a device that made it impossible to drain the engine dry of oil without first opening the crankcase. Removing the drain plug from a unit which was down, he ran a pipe tap completely through into the interior, and in place of the plug, threaded a 1-in. tank nipple 4 in. long into the hole. On the inner end of this nipple he made up a 1-in. tee, placed with its branch vertically upright, as in the figure.

When a test showed that 4 gal. of oil in the base



would keep the circulating pump filled, this amount was doubled for safety, and the level to which this would fill the base carefully determined. Into the branch of the tee was screwed a short nipple, cut so that its upper edge would come to the 8-gal. level. With the other opening of the tee closed with a plug and cap on the nipple, the engine base was filled as usual. Then, when it was desirable to remove the oil the cap was taken off and the oil drained in the usual manner, without danger of robbing the engine of its necessary safe margin of oil.

Careful check-ups on the quality of the oil showed that, although one-fifth of the initial charge was held back by the drain, it was not necessary to make the routine oil changes oftener than every two weeks. Periodic cleanings at times when the diesel was down for valve overhaul was sufficient to free the sump of accumulated carbon. Since installing a similarly fitted tee in each engine of this station, not one bearing has been damaged, nor has it been necessary to shut down to change the oil.

Longview, Texas. ELTON STERRETT

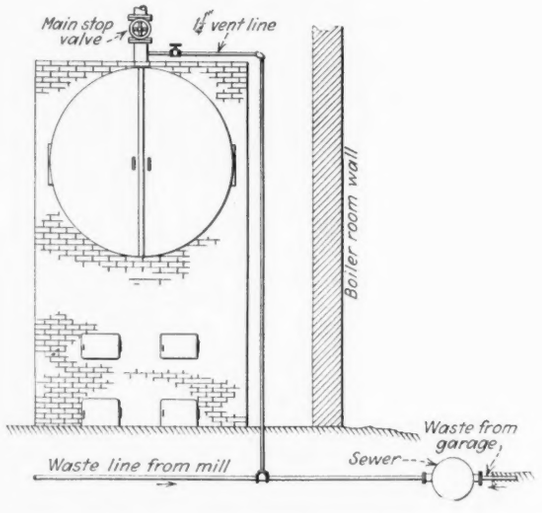
Boiler Bulged by Garage Oil

A RATHER peculiar case of bulging in a boiler happened in a small plant recently. Horizontal tubular boilers were installed to operate at 25 lb. pressure. All steam generated went through the building heating system and indirect-process coils. Feedwater was condensate with a small amount of makeup from the municipal water system. As no pumps or reciprocating steam equipment were used, oil in the boiler was thought to be practically impossible.

During the warmer heating seasons, such as spring and fall, the main stop valve was closed at night, so that the mill rooms would not be too hot in the morning. Several times under these conditions, the banked fire would burn through during the night and cause blowing of the safety valve. To prevent this, a $1\frac{1}{4}$-in. valved vent line was piped from between the main stop valve and the boiler to the sewer, as in the figure. When the pressure fell to a low value in the evening, the stop valve was closed and the vent valve opened. Incidentally, the boiler was equipped with an automatic feedwater regulator so that low water could not occur when the boiler was banked.

After starting the boilers one morning, the fireman noticed a serious bulge in the lower shell plate over the fire. When the boiler was opened for inspection, a heavy coating of oil was found on the internal surfaces, much of it having baked on to the lower shell plates, which had consequently overheated.

After much puzzled tracing of the entire piping system, the solution was discovered. A garage located

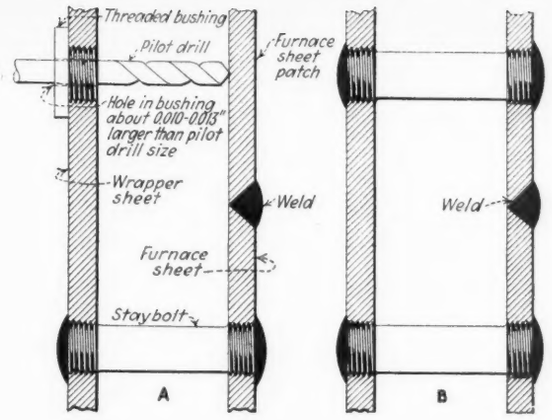


next door had been dumping old crankcase oil into the sewer. When the vent valve was left open at night, steam condensed in the boiler and created sufficient vacuum to draw oil and sewage into the boiler. Needless to say, the vent line was changed to discharge to atmosphere. In similar installations where it is necessary to pipe such a vent to the sewer, a check valve should be installed.

Boston, Mass. C. O. DIBBLE

Getting Staybolt Pilot Holes in Correct Alignment

IN INTERNALLY FIRED (firebox-type) boilers having the furnace sheets staybolted to the outer sheets, defects sometimes develop in one of the furnace sheets. These may be caused by excessive corrosive action or burning of the sheet when the internal surfaces are covered with scale or oil. It is often good practice to cut out the defective section with a cutting torch, and electric weld in a new section of plate. The new plate should be of the same thickness as the original furnace sheet, and should be of A.S.M.E. physical and chemical specifications for firebox steel boiler plate. Also, the weld should come midway between two rows of staybolts, as in the figure.



When drilling the new plate for the threaded staybolt holes, much future trouble from leaky and breaking staybolts will be eliminated if the new holes are in correct alignment with the holes in the wrapper sheet. A collar bushing can be made having external threads to match those in the staybolt holes, as in the figure. This bushing is screwed into the wrapper sheet as shown, and it serves as a convenient and accurate guide for drilling the pilot hole.

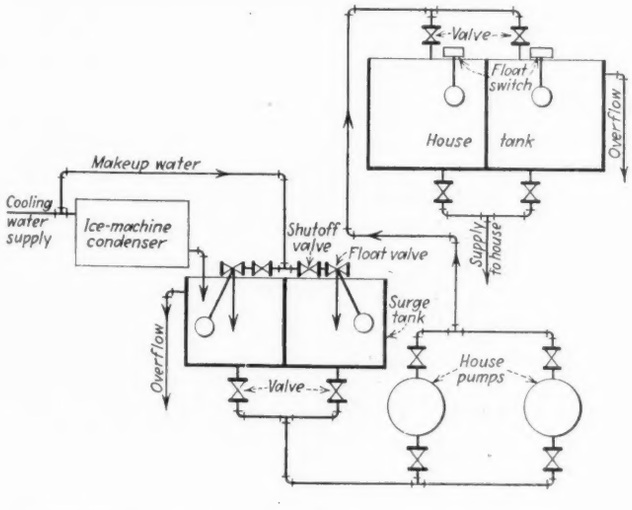
Chicago, Ill. R. O. BILLINGS

Reducing House-Tank Size Cuts Water Cost

WE HAVE FOUND that by a simple change in our operating procedure a considerable saving in service water can be made in our plant. Water from our ice machine condensers discharges to a surge tank, which supplies the house pumps, as in the diagram. A minimum water level for the pump is maintained in this tank by float-controlled valves in the makeup water line.

In the fall and winter when refrigerating load is light, all water from the condensers is readily absorbed in the service-water system. During summer months when there is a large refrigerating load, a considerable amount of the condenser water ran to waste through the overflow from the surge tank. When the house pumps were operating, some make-up water was required before the house tank would be filled.

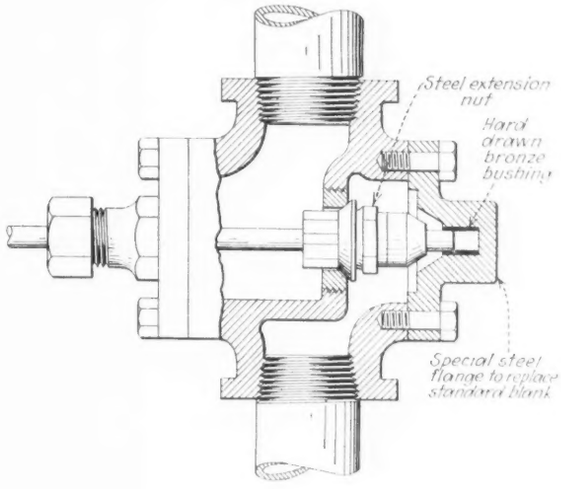
It was decided that if the house pumps could be made to operate more frequently a more even transfer of water from the surge to the house tank would obtain, with a resulting saving in water. This was accomplished by using only half of the house tank at one time in summer. Now the house pumps operate about twice as frequently as when two sections of the house tank are used, and water that previously ran to waste from the surge tank is now used for service purposes. A 110-volt lamp connected to a small float switch in the surge tank indicates when water level in this tank is within 3 in. of the overflow.



Chicago, Ill. ABE ROCKLIN

Change in Valve Stem Stops Leaks

ON OUR steam-jet vacuum ash-conveying system, the valve, which controls the steam at 420 lb., to the nozzles could not be kept steam tight except for a short time. It was necessary to renew the valve and seats every three to four months. Inasmuch as the conveyor was operated only about two hours each day, maintenance on this valve was excessive. The valve is opened by a motor-driven centrifugal fly-ball thrustor and remains open for about 80 sec., then it is closed by springs for about 5 sec., after which the cycle is repeated. Starting and stopping of the valve motor is done by a mercoid switch.



Damage to the valve was found to be due to vibration of the valve on the inner surface of the seat. In an attempt to eliminate this vibration, an extension nut was made to fit the end of the valve spindle and a special cover designed for the valve body. The extension part of the nut is supported in a bronze bushing fitted in the body cover, as in the figure. This simple change, made at comparatively little expense, has completely eliminated the valve-seat trouble, the valve remaining tight after nearly two years of operation.

Winnepeg, Man. C. L. ALEXANDER

Detecting Leaks in Compressed-Air Lines

SMALL leaks in compressed-air lines are frequently difficult to detect. One way in which they can be located is to place a rag soaked in amyl alcohol before the air intake, which will give the air a characteristic odor that can be detected wherever there is a leak.

CURRENT COMMENT

Test Condensate for Oil Content

ON PAGE 538 of the June *Power*, a suggestion is given by C. O. Dibble for testing condensate for oil content. It may be interesting to know that in all sugar factories and on steamships here in the Netherlands East Indies, also on steam dredges in Malaya, an apparatus is used which gives the oil content of the condensate by direct reading in milligrams of oil per liter of feedwater. This is the so-called Martin Oleometer.

Batavia-Centrum, Java.

N. J. DE GEEST
Chief Lubricating Engineer, Standard-Vacuum Oil Co.

Conduit for Wound-Rotor Motor Wiring

AFTER reading the answers to Question No. 2 in September *Power*, I wish to add that there is no rule or regulation of the National Board of Fire Underwriters, or any of the societies interested in the industrial power wiring methods, prohibiting installation of both primary and secondary wires between a wound-rotor induction motor and its controller in the same conduit. The common practice of installing the primary and secondary wires from the motor terminals to the control equipment, in separate conduits of externally controlled wound-rotor induction motors seems to have become customary when installing this motor without mandatory regulations.

However, there are several obvious advantages in this practice, although it is not specifically required in conforming to power-wiring regulations of the Code. It permits, in many instances, location of the controller in the most convenient place for the operator. Greater accessibility of the controller and its accessories for inspection and maintenance can be provided when the primary and secondary wires are kept separate. In case it becomes necessary to pull-in new wires in either circuit it can be done readily without disturbing those of the other. It also permits greater flexibility in locating the resistor and other parts where ventilation is considered an important factor.

St. Marys, O. J. L. YOUNG

More on Leaky Tube Ends

FOURTEEN reasons for leakage at the upper, rear tube ends in a horizontal tubular boiler are given in July *Power*.

There is one possibility not offered that is sufficiently important and common to warrant heading the list. This is having the lowest visible part of the gage glass too low, usually through an improperly installed water column. The bottom nut of the gage glass should be at least 3 in. above the top row of tubes. Failure to check this at time of installation often results in the leakage described by S.H.M.

This leakage would not always appear at once in a new boiler. If the boiler is not operated at high ratings to immediately damage the exposed upper tube ends, they will fail after gradual overheating and deterioration.

A second possible cause of this trouble (not mentioned) is that of settling of the boiler foundation or settings at the front. Excessive settling would leave the upper rear tube ends bare, though a safe water level showed in the glass.

New York, N. Y. HARRY M. SPRING

Cause of Pounding Pump

THE following discussion is submitted on the assumption that the Question For Our Readers on "Cause of Pounding Pump" in August *Power* should have read "the boiler-feed pumps began to pound" instead of "the pumps feeding the water heater . . . "

Whenever the supply of exhaust steam is not adequate for the requirements of the heating system, the radiators will cool off, causing the thermostatic traps to open wide, and pressures in the supply and return lines will tend to equalize. Pressure in the supply line will be below atmosphere, and the engines are exhausting to a vacuum, depending of course upon vacuum carried at the heating-system vacuum pump, steam flow, radiator demand, line loss and other factors. Since the heater is connected to the exhaust line it will have the same pressume or vacuum.

Operation of a boiler-feed pump which receives its supply from an open heater requires that it have a positive suction head at the pump inlet, the necessary head being dependent upon the temperature of the water. It has been found in practice that from 10 to 15 ft. static head is satisfactory when the water temperature does not exceed 220 deg., this head being obtained by elevating the heater above the pumps. This static inlet pressure is necessary to counteract the tendency of the pumps to become steam-bound when handling hot water, which condition causes them to pound.

Let it be assumed that there is a static head at the pump inlet of 12 ft., which will correspond approximately to a pressure of 5 lb. This will be satisfactory when the water temperature is 210 deg. and pressure in the heater 3 lb. If the water temperature dropped to 180 deg., it would only be necessary to have a static head of 5 ft. or about 2 lb. pressure at the pump inlet. Assume also that about 10 to 11 in. of vacuum are carried at the vacuum pump and a 6 in. vacuum is found in the exhaust line at the engines and also in the heater, the inlet pressure at the pump will then be the algebraic sum of the pressure due to the static head of 12 ft. plus the 6-in. vacuum in the heater. The net inlet pressure will then be 2 lb. This inlet pressure will be satisfactory as long as water temperature does not rise above 180 deg. or vacuum does not exceed 6 in. in which cases the pump would become steam-bound and begin to pound.

If all condensate from the heating system is returned to the heater, the amount of make-up will be small, and since, as will be pointed out later, there will be no flow of exhaust steam to the heater, the temperature of the feedwater will be approximately that of the heating returns. It would be natural to expect that, with the supply of steam to the heating system far smaller than the demand, returns would be considerably cooled off. But the presence of a few leaky traps in close proximity to the vacuum pump would raise the temperature to that corresponding to the vacuum carried. In addition it is usual to have all high-pressure traps discharge to the heater. If these traps operate intermittently, feedwater temperature will vary somewhat depending upon the quantities and periods of discharge. Since it has been assumed that the vacuum carried at the pump is 11 in., the corresponding temperature of which is 190 deg., it is quite possible to have the water in the heater at a temperature higher than can be handled by the pump with the available inlet pressure.

For the feedwater heater to function, there must be a continuous flow of steam into it. As the steam heats the water, non-condensable gases (air and CO_2) are released and escape to the atmosphere through a vent line. With a vacuum in the heater, discharge of these non-condensable gases is prevented, and air will flow back through the vent, stopping the flow of steam into the heater. As the vent line is usually of small diameter, there will not be enough air entering to break the vacuum in the heater.

As a temporary expedient, the vacuum pump may be slowed down until pressure in the exhaust rises enough to stop the pump pounding. Since the heater is not functioning as such, the valve to the heater from the exhaust line may be closed, until the supply of exhaust steam again becomes normal.

A practice not recommended is to feed enough live steam through a reducing valve to hold back-pressure at all times above atmospheric.

The most practical and economical solution is to install a valve in the line to the heating system so that pressure in the exhaust line and in the feedwater heater will always be above atmospheric and allow only the surplus steam to go to the heating system. This valve would be in the nature of a back-pressure valve and could be either manually or automatically operated. If a gate valve is installed in the line, it would be possible to use this, although it is not desirable. The best valve for this purpose is a butterfly, as cost is low and it is easily adjusted. It can be made automatic by connecting its operating lever to a small diaphragm-operated reducing valve.

One other bad feature of operating a plant under the conditions stated is that any traps on the exhaust line discharging to atmosphere will not function. Such a condition would have the effect of retaining any oil or oily drips in the system and eventually depositing them in the boiler. Since a turbine is in operation during light-load periods it is apparent that no trouble of this sort is experienced, but should one of the engines be operated instead, oil will soon appear in the boilers.

Clyde, N. Y. JULIUS BRODSKY

Boiler-Room Procedure For Safe Operation

I BELIEVE that I may give some helpful suggestions and criticism regarding the above article in August *Power*. The author states under water column, "If the fouling occurs frequently, it is due to some characteristic of the water, such as suspended matter, scale solvents, lubricating oils, etc., for which a remedy should be found." If lubricating oil or any oil was noted in the water glass, the proper thing to do is to get the boiler off the line as soon as possible, for oil in boilers is dangerous and should receive immediate attention.

We are also told to test try cocks, etc., every 12 hr. I would change this to read as follows: "The try cocks, water glass and column, blowoff valves, feedline valves and safety valve should be tested and tried by each operator upon taking up his duties." and before the leaving operator turns the boilers over to him." This precaution is taken, not only to see that all appurtenances about the boiler are in good order but that each operator upon assuming his duties knows their condition. He should also examine all parts of the boiler as far as possible and be sure there are no defects that can be laid against him if the blame belongs to the previous operator.

We are also told great care should be exercised in using a wrench or bar in opening or closing valves, etc. Now I consider this a dangerous practice and the use of any wrench or bar upon any valve stem or wheel should be forbidden. If a valve will not hold without resorting to this unsafe practice, there is something wrong with the valve.

Before firing a boiler to take its share of the load, the author says to lift the lever of the safety valve, etc. The lift lever of the safety valve should never be used unless there is pressure in the boiler sufficient to blow all sediment and foreign material from the body of the valve.

If readers want to get real safety in boiler rooms, I would suggest that they get a copy of "Suggested Rules for the Care of Power Boilers," as issued by the A.S.M.E. and follow out the instructions given therein.

Binghamton, N. Y. CHARLES W. CARTER, JR.

More Things Wrong With Compressed-Air Picture

REFERRING to Harry Spring's sketch of a "Compressed Air System" in April *Power*, I wish to submit the following additional items, which should be included for safety reasons:

1. If possible, the air tank should be installed outside the building.

2. The tank is of such size that a manhole should be installed in the head or shell for proper inspection. See Massachusetts and A.S.M.E. Codes.

3. The air tank is not properly supported. See Massachusetts and A.S.M.E. Codes.

4. Massachusetts Code requires that a permanent ladder be installed in a tank of this size to aid in ingress and egress, when the manhole is in the top head.

5. Drip pipe on the air receiver should be installed at the lowest water space and should be ¾-in. in diameter. No globe valves should be used and the valve should be opened at least once a day to drain oil and water.

6. The Massachusetts Code requires at least one fusible plug after every air compressor.

7. Siphon mentioned should be of brass or other non-corrosive material.

8. The picture shows the bottom head to be flat, and, therefore, the tank would not be good for 100 lb. pressure. The bottom head should be dished, either concave or convex, and of proper thickness.

9. Intake air should be taken from outdoors, if possible, to provide cool and clear air. A filter should be used.

10. If plant is above the sea level (which is not stated in sketch) the safety-valve calculations would have to be adjusted accordingly. Should not the pressure absolute be 124.7 lb. instead of 110 lb. as used in making the safety-valve calculation under Item 1?

Buffalo, N. Y. JOHN J. TIMMONS

Another Feedwater Data Source

IN September *Power*, under "Current Comment," R. W. P. asks for information regarding sources of information on boiler-water testing and the limits to which the various tests should be carried.

W. J. Ryan, replying to the inquiry, neglected to mention "Boiler Feed and Boiler Water Softening" by H. K. Blanning and A. D. Rich, published by Nickerson & Collins Co., Chicago. It is our belief that this book will give R. W. P. just exactly the information which he wants and we further believe that he will be unable to get this information in any other one volume.

Chicago, Ill. H. A. GUSTIN,
Asst. Director of Service,
National Aluminate Corp.

Sulphate and pH

WILL *you please give us any information you may have on quantitative analysis of sulphite in boiler water. We also wish information as to the minimum and maximum pH values on boilers operating at 475-lb. pressure.*—G. O. G.

(The following reply was prepared by Wm. J. Ryan, Water Service Laboratories, Inc., New York, N. Y.—Editor.)

The standard thiosulphate method of determining sodium sulphite is as follows: Obtain a fresh sample of boiler water drawn through a cooling coil. Measure 10 cc. of N/40 iodine solution into a porcelain dish. Add 5 cc. of glacial acetic acid. Add slowly, while stirring, 100 cc. of the boiler water. Next add standard N/40 sodium thiosulphate solution from a burette, while stirring, until the brown coloration due to the iodine nearly disappears. Next add one cc. of starch indicator and continue to titrate with thiosulphate until the blue color disappears. From the burette read the number of cc. of N/40 thiosulphate solution used and record as *S* reading. Repeat the procedure using 100 cc. of distilled water in place of boiler water. Record this burette reading as *W*.

$(W—S) \times 15.8 =$ p.p.m. of sodium sulphite (Na_2SO_3) in boiler water.

Another method suggested by a large manufacturer of sodium sulphite is as follows: The solutions required are:

(a) Hydrochloric Acid, chemically pure concentrated.

(b) Starch Indicator: Dilute a thick paste made from 1 gram soluble starch and a little water, with 100 cc. of boiling water.

(c) Standard Potassium Iodide, Potassium Iodate Solution: Dissolve 0.710 grams of potassium iodate (KIO_3) in 100 cc. of distilled water and add 7 grams potassium iodide (KI) and 0.5 grains sodium bicarbonate. Dilute the above mixture to exactly one litre and place in a 1-litre reagent bottle.

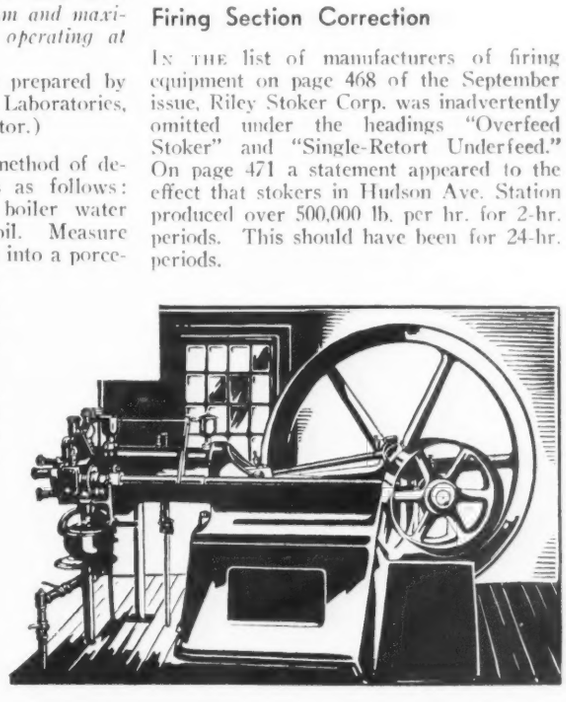
The procedure for making the test is as follows: Place 1 cc. of concentrated hydrochloric acid in a 300-cc. casserole and pour in 250 cc. of cooled boiled water. Add 1 cc. of the starch indicator while stirring. Place 10 cc. of the potassium iodide iodate solution in a burette and add it slowly to the solution in the casserole with constant stirring until a trace of blue color appears. Read from the burette the number of cc. of potassium iodide iodate solution used. This number multiplied by 5.0 is the amount of sodium sulphite in the boiler water in parts per million.

The potassium iodide, iodate and the hydrochloric acid solutions are stable, but the starch indicator should be renewed every three to five days to obtain a good end point. Medicine droppers marked for 1 cc. can be used for handling the hydrochloric acid and the starch indicator.

Regarding the pH of the boiler water, if it is kept at about 10.8 to 11 and if the feedwater is deaerated, corrosion should be minimized.

Firing Section Correction

IN THE list of manufacturers of firing equipment on page 468 of the September issue, Riley Stoker Corp. was inadvertently omitted under the headings "Overfeed Stoker" and "Single-Retort Underfeed." On page 471 a statement appeared to the effect that stokers in Hudson Ave. Station produced over 500,000 lb. per hr. for 2-hr. periods. This should have been for 24-hr. periods.



READERS' PROBLEMS

QUESTIONS for Our Readers

Short Belt Life
Question 1

SINCE *starting up our new plant we have experienced what we consider short belt life. I shall appreciate it if POWER readers would tell me what are some of the factors that might cause this condition.*—B.E.N.

Diesel Exhaust Noise
Question 2

WE HAVE *two large 8-cyl. diesels driving centrifugal pumps through right-angle drives. Though of different makes, each has an exhaust manifold along one side, running directly into an 8-in. welded-steel pipe which right-angles outside the building through a muffler. One engine runs quietly, the other has a pulsing exhaust note that can be heard for a mile or more. Both engines run smoothly and create no vibration. What are possible causes of the noise, and can POWER readers suggest remedies.*—C.V.C

Suitable answers from readers will be paid for if space is available for publication.

Removing Dust from Air Ducts
ANSWERS to September Question 1

OVER *a period of years, a closely packed deposit of dust has accumulated in the ducts that carry conditioned air to our building. We would like very much to clean these but have not found any practical method and will appreciate suggestions from POWER readers. Ducts are both round and square and of course vary in size from small to large ones about 30 in. in diameter.*—E.P.W.

Glossy Paint Keeps Duct Clean

REMOVAL of the dust that collects in the ducts usually has to take place when the system is shut down. Only a few installations can be closed off with dampers or other protective devices form the space served. A vacuum cleaner is the most satisfactory way of removing the dust. Where duct construction is such that they can be disconnected, this cleaning is simplified. Where the ducts cannot be taken apart, openings with dampers or hinged covers can be made. These openings, preferably in the top if it can be reached, have to be made about every 16 ft., and the cleaner attachment can reach each way from the opening.

A coating of high-gloss paint on the inside of the ducts helps to keep them clean. This offers very little chance for dust to start collecting. It seems as though most of the trouble in the systems is caused by the collection of dust breaking loose every once in a while. If the places where it collects, either through roughness or eddy currents, can be eliminated, the dust problem will be reduced.

Lakewood, Ohio J. P. SIMONS

Use Suction Hose To Remove Dust

ONE of the first things that suggests itself is the introduction of a suction hose into the ducts, and passing it through each one in turn. With closely packed dust, the trouble is that a channel will be cut along the bottom of the duct through the dust, and the balance of the packed material will in many cases remain bridged over the hose. This, however, can be overcome by the simple expedient of vibrating the duct at the same time the suction hose is passing through it. For this purpose, a power hammer can be used to advantage, heavily cushioned with sponge rubber or felt in order to obtain fairly violent vibration of the duct without giving it any blows of sufficient violence to do it actual harm. If some practical means can be found to keep the hammer operating at approximately the same spot on the outside of the duct as the hose nozzle occupies on the inside, the operation will be more efficient and effective. One method of doing this is marking the duct at 3-ft. intervals from the hose inlet, using a piece of soapstone or other suitable material for the purpose, and also marking the hose at like intervals. Very close accuracy can be maintained in this respect by simply stretching the hose along the duct to be cleaned, and marking both at the some time, at intervals of one yard.

PEORIA, *Ill.* JOHN E. HYLER

Operating on Reduced Pressures
ANSWERS to September Question 2

WE HAVE *a condensing 1,500-kw. turbine designed to operate on steam at 350 lb. pressure and 600 deg. At present this unit is way underloaded, never carrying more than 400 kw. Under this low load, pressure on the first-stage nozzles is only about 170 lb. As we have no use for steam at pressures higher than 150 lb., would we save steam by reducing our boiler pressures?*—M.J.P.

Consult Boiler Manufacturer Before Low-Pressure Operation

NEGLECTING a possible increase in boiler efficiency, M.J.P. will obtain no improvement in economy by decreasing his steam pressure.

When the throttle, acting as a reducing valve, lowers the pressure at the first-stage nozzle of the turbine to 170 lb., it also lowers the temperature to 570 deg., while total heat remains at 1309.4 B.t.u. If the turbine exhausts to, say, 28½-in. vacuum, the heat available due to adiabatic expansion is 386 B.t.u., which is 29.5% of the heat in the initial steam.

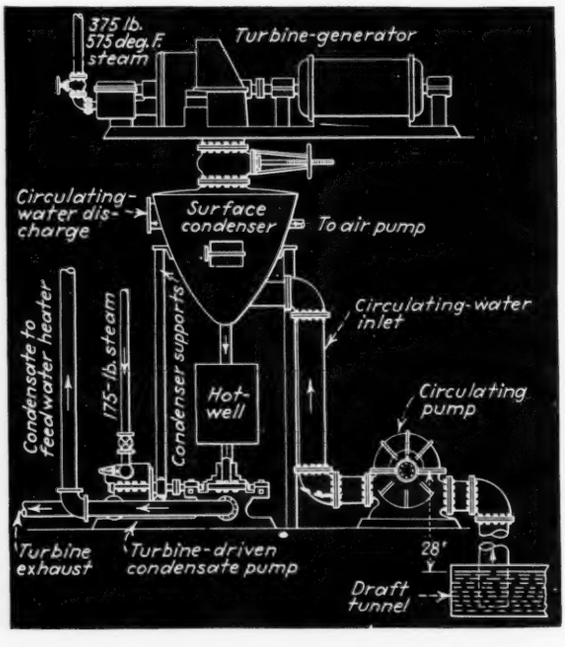
If the steam pressure on the boiler is reduced to provide 170 lb. pressure at the first stage of the turbine with the governor valve wide open, heat available will depend upon the steam temperature. Just what the superheat will be is not easy to predict. The final temperature of the steam will certainly not be more than 600 deg., and is more likely to be about 536.7 deg., which is the same superheat as obtained with high-pressure operation of the boiler.

With 170-lb., 600-deg. steam, the heat content is 1,323 B.t.u., and the heat drop to 28½ in. vacuum is 391 B.t.u. Assuming the same turbine efficiency, this will result in a slightly lower steam rate, but note that the available heat is 29.5% of the heat in the initial steam. This is the same as with high-pressure operation, and there is therefore no gain in thermal economy. If the steam temperature is 536.7 deg., the heat drop is 374 B.t.u., which is 29.1% of the heat in the initial steam. Therefore operation would be *less* efficient.

A more important point to be considered than any economy gain is the operation of the boiler at the reduced pressure. The volume of steam released in the boiler drums when operating at 170 lb. is just

WHAT'S WRONG WITH THIS PICTURE?—IX
Steam Turbine and Condenser System

There are at least 28 mistakes shown in this drawing. Make a list of those you recognize, then check against the list on page 626.



twice that when operating at 350 lb. This greater volume of steam may cause priming if operation at the reduced pressure is attempted. Consequently the boiler manufacturer should be consulted before making the change.

New York, N. Y. P. R. BROCKNER

Economy of Low-Pressure Operation Depends on Steam Temperature

DUE to the effect of throttling, M.J.P.'s turbine, when running at a load of 400 kw., is operating on steam at 170 lb. ga. and 570 deg. The question before us then becomes: "Will the existing steaming equipment, when operated to deliver 170 lb. gage with the throttle wide open, give a steam temperature above or below 570 deg.?" If it gives above 570 deg. then there will be an increase in B.t.u. per lb. of steam delivered, consequently the water rate will be decreased. If the steam temperature is lower than 570 deg., the water rate will increase.

It seems logical that when the firing rate is reduced in keeping with the reduced boiler pressure, the heat transfer in the superheater will likewise be reduced proportional to the reduction of heat transfer in the boiler proper. Consequently, it may be expected to produce a steam temperature well below the necessary 570 deg. F., thereby resulting in an increased water rate. This is of course only theory and the best answer would be obtained by test. I suggest that M.J.P. run his boilers at reduced pressures approaching the 170 lb. limit and measure the steam temperature ahead of the first stage.

Bronxville, N. Y. EDWARD H. RADER

Low-Pressure Operation Less Economical

I BELIEVE that reduced- or variable-pressure operation in certain cases deserves more serious consideration than it has received in the past. This, however, applies only to pressures above that at which saturated steam attains the maximum heat, or about 425 lb. gage.

Saturated steam at 350 lb. gage contains 1206.6 B.t.u. total heat, and saturated steam at 150 lb. gage has a total heat content of 1195 B.t.u., a reduction of 11.6 B.t.u. The superheater input would be the same in either case. Since turbine nozzle pressure is 170 lb. with the 400-kw. load, boiler pressure could not be lowered below about 200 lb. with a heat reduction of 7.4 B.t.u. per lb. While this slight reduction in total heat may seem small, it is sufficient to increase steam flow, with the accompanying increase in condenser losses which will more than offset any slight gain in boiler efficiency. There is also the possibility of increased blade erosion in the low-pressure stages.

South Amboy, N. J. RAYMOND SEPTOR

Turbine Less Efficient

IF THIS turbine is designed for operation on steam at 350 lb. and 600 deg., its efficiency will be less if it is operated with steam at 170 lb. However, this does not appear to be a major consideration, as the load is light and efficiency is low anyway.

The nozzle area necessary when the turbine is fully loaded is fixed by the amount of steam that must enter in order to carry the load. If the initial pressure is reduced to 170 lb., the amount of steam that can be passed through the nozzles of the first stage will be reduced to about half of the amount they will pass at full 350-lb. pressure, and due to the reduced efficiency the maximum capacity of the machine will be somewhat less in proportion.

Apparently there is use for process steam at 150 lb. I suggest leaving the pressure at its present value and bleeding steam at 150 lb. If all the steam which the first-stage nozzles are capable of carrying is bled at 150 lb., about 300 kw. can be developed. Some steam will have to be allowed to pass to the condenser at all times to keep the low-pressure stages of the turbine cool. For loads greater than 300 kw. some additional steam will have to be allowed to pass on into the condenser. This method of operation will permit the carrying of any load up to 1,500 kw. and at partial loads will furnish process steam. The cost of steam for power, if properly prorated between power and process, will be minimum.

Corvalis, Ore. WALLACE H. MARTIN

WHAT'S WRONG WITH THIS PICTURE?—IX

Steam Turbine and Condenser System—See Page 624

ERRORS shown are restricted to steam and water piping, and to appurtenances, appliances, and instruments necessary for proper, safe operation. For clarity, electrical errors and oil piping are not shown.

1. *No Throttle Drain.* A drip line is required just above the throttle valve in the steam line of both the main turbine and the auxiliary turbine. Without this connection, accumulated condensate may damage the turbine seriously when the throttle is open. Drip lines are preferably piped to a trap, to assure against the possibility of damage.

2. *Double Throttle Preferred.* Two steam valves are preferred on the main line to large turbo-generator sets. The main throttle should be installed next to the turbine, with the auxiliary valve between this throttle and boiler pressure. In case of accident or jamming of the service throttle, the auxiliary steam valve is used.

3. *No Pressure Gage at Throttle of Either Main or Auxiliary Turbine.* A gage indicating throttle pressure is essential to proper turbine operation.

4. *No Pressure Gage on First Stage of Main Turbine.* A gage should be provided to indicate first-stage pressure—showing response of governor to load changes.

5. *No Tachometer.* Some type of speed-indicating instrument is essential on the main turbine; especially when starting the turbine, and when checking operation of overspeed trip.

6. *No Thermometer in Main Steam Line.* Some accurate type of temperature-indicating or recording instrument should be provided in the main turbine steam line when superheated steam is used.

7. *No Steam Seal or Gland Connections Shown on Main Turbine.* Steam seal and gland leak-off piping should be provided.

8. *No Drains on Main Turbine Casing.* Valved or trapped drips are required on the low points of the main turbine casing, to prevent accumulation of condensate. Such an accumulation would result in corrosion when the unit stood idle, and might cause damage when starting up.

9. *No Atmospheric Valve on Main Turbine.* An atmospheric relief valve should be provided between the main turbine and the exhaust nozzle shut-off valve. This is necessary to protect the turbine casing if the unit is accidentally started with a closed exhaust. It also protects the condenser in event of circulating—water failure. If there is no valve in the exhaust nozzle, as is generally the case, the atmospheric relief valve is connected to the condenser.

10. *No Expansion Joint in Main Turbine Exhaust Connection.* If the condenser is rigidly supported, an expansion joint should be provided between it and the turbine. If no expansion joint is used, the condenser should be supported on springs. It protects the turbine casing, condenser shell, and connections against leakage or failure.

11. *No Gage Glass on Hot-well.* A gage glass should be provided to serve as a check on condensate-pump operation.

12. *No Shut-off Valves on Condensate Pump.* Shut-off valves in the discharge and intake are often necessary when making repairs on the pump.

13. *No Check Valve in Condensate Pump Discharge.* A check valve is required when pumps from more than one unit discharge to a common header.

14. *No Drain on Hot-well.* It is often convenient to drain the hot-well through a valved drain rather than through the condensate pump when the plant is shut down.

15. *No Thermometer on Hot-well.* A thermometer should be provided to check operation and efficiency of the condenser.

16. *No Equalizer Line to Condensate Pump.* A vacuum-equalizer line from the condenser to the pump casing results in a large increase in pump capacity and efficiency.

17. *No Pressure Gage on Condensate-Pump Discharge.* A pressure gage should be provided to check on proper operation of this pump.

18. *No Separator on Steam Line to Auxiliary Turbine.* A properly drained separator is desirable just above the throttle valve in auxiliary turbines—especially when using saturated steam.

19. *No Exhaust Drip for Auxiliary Turbine.* As shown, a considerable amount of condensate could collect in the exhaust line of the auxiliary turbine. A valved drip should be provided.

20. *No Thermometer on Circulating-Water Line.* Thermometers should be provided to check temperature of circulating water in and out of the condenser. These readings are important in determining cleanliness and operation of the condenser.

21. *No Vacuum Gage.* It is important to provide a reliable type of indicating

instrument to show vacuum with a condensing turbine.

22. *Circulating-Pump Lift Too High.* A lift of about 20 ft. is the practical limit for a centrifugal pump, assuming a maximum water temperature of 80 deg.

23. *No Shut-off Valves on Circulating Pump.* A shut-off valve is required on the pump discharge at least. It is necessary to close off the discharge when priming the pump.

24. *No Circulating-Pump Priming Connection.* An air-ejector connection is required at the highest part of the pump casing; otherwise, priming would be impossible.

25. *No Vacuum Gage on Circulating-Pump Suction.* A vacuum gage, while not essential, is highly desirable on this connection. It serves to check the water level in the draft tunnel, and check operation of the pump.

26. *No Drain on Circulating-Pump Discharge.* A drain should be provided to empty the circulating-water piping to the condenser when the plant is shut down and the pump valves are closed.

27. *No Drain or Vent on Condenser Water Box.* A vent and drain are necessary when opening the condenser water box for cleaning or inspecting.

28. *No Vent on Condensate Pump.* A vent should be provided in the top of the casing to aid when draining, or starting the pump when air-bound.

Flushing, N. Y. HARRY M. SPRING.

MANUFACTURER'S BULLETINS

Elevators—Chelsea Elevator Co., New York, N. Y. Loose-leaf catalogs on dumb-waiters and elevators, including service sheets to aid in proper selection. Also list of contracts.

Pulverized Coal—Whiting Corp., Harvey, Ill. 16-page Bulletin No. 199, "Lower Steam Costs With Pulverized Coal Firing." Gives cross-sections, engineering data, specifications.

Automatic Control—Automatic Temperature Control Co., Inc., 34 East Logan St., Philadelphia, Pa. Three bulletins: 4-page Bulletin G-9, "Industrial Controls, Regulating Temperature, Time, Level, Flow, Pressure," also 4-page Bulletin G-10, on motor-operated controllers, and 2-page Bulletin 115 on automatic reset cam timers.

Dust Counter—Bausch & Lomb Optical Co., Rochester, N. Y. 4-page folder, "The Bausch & Lomb Dust Counter Will Help You Solve Your Dust Problem."

Diesel Units—The Buda Co., Harvey, Ill. 8-page Bulletin No. 905, "Buda Diesel Power" illustrates typical installations and gives design data.

Pumps—The Allen-Sherman-Hoff Co., Lewis Tower, Philadelphia, Pa. 24-page Catalog No. 836 on "Hydroseal" pumps for sand, slime, sludge and slurry, with soft rubber internal parts. Many cross-sections, installation photographs, design data, 2-color illustrations, etc.

Penetrating Oil—Alox Corp., P. O. Box 564, Niagara Falls, N. Y. 3-page mimeographed Bulletin J-36, giving data on penetrating oils.

Temperature Control—The Foxboro Co., Foxboro, Mass. 4-page folder on use of temperature controls in manufacture of giant 200-in. telescope disk for California Institute of Technology.

Liquid Level Controllers—Kieley & Mueller, Inc., New York, N. Y. 24-page Bulletin C on liquid-level controllers with ball-bearing spindles and easy-to-pack stuffing boxes. Gives cross-sections and detail data.

Rubber Isolation—United States Rubber Products, Inc., 1790 Broadway, New York, N. Y. Special manual on application of rubber mountings to industrial use. Gives engineering data indicating various characteristics.

Mechanical Transmission—Morse Chain Co., Division of Borg-Warner Corp., Ithaca, N. Y. 50-page catalog of Morse Stock Drives. Shows complete lines of silent chain drives, sprockets, chains, couplings, and associated equipment, including application tables.

Stokers—Beacon Stoker Co., Inc., Beacon, N. Y. 12-page Bulletin on hydraulic underfeed ram-type "Hyd-ramic" Beacon Stoker.

Dowtherm—Dow Chemical Co., Midland, Mich. 35-page elaborately illustrated bulletin on "Dowtherm for High-Temperature Heat-Transfer Systems."

Controllers—Brown Instrument Co., Wayne & Roberts Aves., Philadelphia, Pa. 4-page folder on controllers entitled "Here's The Answer to Your Temperature Problem."

Cranes—The Cleveland Crane & Engineering Co., Wickliffe, Ohio. 20-page loose-leaf bulletin on various types of all-welded cranes showing details and applications.

V-Belt Drives—Rockwood Manufacturing Co., Indianapolis, Ind. Two catalogs: 12-page, "Rockwood Single-Groove V-Belt Drives," called Data Book No. 783, giving detailed specifications and center distances; also Data Book No. 782, with 32 pages of data on multi-V-belt drives.

Voltage Regulators—Allis-Chalmers Mfg. Co., Milwaukee, Wis. 24-page engineering bulletin 1183 on Type DFR Distribution Feeder Voltage Regulators for regulating voltage under load on feeders of buses where induction-type feeder regulator has heretofore been used, as well as for larger ratings than heretofore economical.

Arc Welding—The Hobart Bros. Co., Troy, Ohio. 24-page Bulletin "Easier, More Profitable Arc Welding With the New 40-Volt 'Simplified' Welder." Gives details of construction, sizes, etc.

Grinders and Buffers—Marathon Electric Mfg. Corp., Wausau, Wis. 12-page folder on various types of units.

Ventilating Fans—Marathon Electric Mfg. Corp., Wausau, Wis. Two bulletins: 4-page "Super Air Screws," and 4-page Bulletin 5-36-5M, "At Last a Real Ventilator."

Motors—Marathon Electric Mfg. Co., Waasau, Wis.—Number of small 4-page folders on various types of motors for all services.

Pipe Tools—Beaver Pipe Tools, Inc., Warren, Ohio—30-page Catalog No. 37 giving complete list of pipe tools, prices, specifications, etc.

Voltage Regulators—Burlington Instrument Corp., Burlington, Iowa. Bulletin No. 401 showing voltage regulators for generating plants of all sizes.

Steam Return Systems—Becker Pump Co., Inc., 1447 Park Ave., Emeryville, Calif., or American District Steam Co., North Tonawanda, N. Y. 4-page folder on Becker condensate and steam-return systems. Shows typical installations and gives design details.

Reciprocating Drive—Ajax Flexible Coupling Co., Westfield, N. Y. 6-page Bulletin No. 20, "Ajax Reciprocating Drive for Screens, Conveyors and Feeders." Gives cross-sections, details of operation and typical applications.

Boiler Water-Level Control—McDonnell & Miller, Wrigley Bldg., Chicago, Ill. 32-page heavily illustrated catalog covering automatic boiler-water feeders, water feeder low-water cutoff combinations, and individual low-water cutoffs.

Heat Transfer—Young Radiator Co., Racine, Wis. Two bulletins, No. 536 showing Young radiators and heat-transfer surfaces in all types of applications, 6 pages, and Bulletin No. 636, showing similiar units for air-conditioning of special applications, 4 pages.

Heat Transfer—Griscom-Russell Co., 285 Madison Ave., New York, N. Y. 8-page Bulletin 1611 shows new design Twin G-Fin Section on heat exchanger with compensated transfer surfaces for heating or cooling fluids of low heat conductivity.

Electrical Specialties—Ideal Commutator Dresser Co., Sycamore, Ill.—40-page Catalog No. 1-936 includes considerable information on motor maintenance and a number of handy electrical tables.

Controllers—The Brown Instrument Co., Philadelphia, Pa. 32-page Catalog No. 8901 on air-operated controllers for temperature, pressure, flow and liquid level. Shows principle of operation, construction and other details.

Labor—Farrel-Birmingham Co., Inc., Ansonia, Conn. "Does Unionism Really Benefit American Labor?" No. 18 in series of bulletins published by this company, covering twelve major non-variable goods industries, accounting for about 2,000,000 wage earners.

Refrigerating Machines—Carbondale Machine Corp., Harrison, N. J. 16-page Bulletin No. 1104 on absorption refrigerating machines showing three types of systems, rectifiers, ammonia condensers, brine coolers, exchangers, absorbers, ammonia pumps and compression machines.

Unit Heating—ILG Electric Ventilating Co., 2850 N. Crawford Ave., Chicago, Ill. 48-page Catalog No. 125 on Unit Heaters, Motors, Specifications, Performance Data, and a number of pages of specialized information on unit heaters.

Water Softeners—Cochrane Corp., 17th St. & Allegheny Ave., Philadelphia, Pa. 12-page Publication 2059 on the Cochrane hot-process water softener of the deaerating type, describing recent developments and the system now in use.

Motors—Marathon Electric Mfg. Corp., Warsaw, Wis.—Loose-leaf catalog on various types of motors, ventilating equipment and similar units manufactured by this company.

Plastics—Westinghouse Electric & Mfg. Co., East Pittsburgh, Pa. Highly illustrated booklet illustrating industrial applications of Micarta, which is available in many forms, grades and shape.

Vibrating Screens—Productive Equipment Corp., 4600 South Kedzie Ave., Chicago Ill. Catalog, "Data on Controlled Vibration and Screen Efficiency," which gives complete data on screening and grading, charts, engineering information and a complete description of this company's vibrating screens.

Coupled Pumps—Cameron Pump Division, Ingersoll-Rand Co. 16-page Bulletin No. 7,066 covering line of coupled pumps from 150 to 5,000 g.p.m. against heads between 20 and 250 ft. for handling nearly all liquids.

Water Works Pumps—De Laval Steam Turbine Co., Trenton, N. J. 8-page reprint of "Reducing the Cost of Operating Centrifugal Water Works Pumps," an article by A. Peterson, chief engineer, Pump and Compressor Department of De Laval, in the *Journal of the American Water Works Association.*

Utility Magazine—Consolidated Edison Co. of New York, Inc., 4 Irving Place, New York, N. Y. "Around the System," a new 32-page monthly magazine distributed to all employees of Consolidated and its affiliated gas, electric and steam companies, replacing three former employee papers: "To Serve New York," for gas company employees, "Metropolitan Electric Topics," for electric company employees, and "The Westchester Round Table," for employees of Westchester Lighting Co. The new house organ is well printed on good quality paper in two colors.

Stokers—Link-Belt Co., 2410 W. 18th St., Chicago, Ill. 28-page book No. 1619 heavily illustrated, shows Link-Belt automatic coal stokers for industrial and commercial use in capacities up to 300 hp. Includes installation and operating data and testimonials from users.

Rolling Doors—Cornell Iron Works, Inc., 3600 13th St., Long Island City, N. Y. 8-page catalog of rolling doors and shutters hand- and motor-operated, showing types and applications; also data on fire-walls and standard rolling doors.

Compressed Air—Worthington Pump & Machinery Corp., Harrison, N. J. 4-page Bulletin L-611-B2A, "Compressed Air at Lower Cost," shows compressors and applications.

Centrifugal Pumps—Worthington Pump & Machinery Corp., Harrison, N. J. 4-page Bulletin W-322-B1A on centrifugal pumps arranged for automatic priming, electrically-operated.

Arc Welding—Lincoln Electric Co., Cleveland, Ohio. 20-page Bulletin No. 412, "The New Arc Welding Technique with the Lincoln 'Shield-Arc S.A.E.' Welder." Highly illustrated. Show details of using new welder.

(*Further Bulletins on Adv. Page* 48)

THE ENGINEER'S BOOKSHELF

Electrical Code

NATIONAL ELECTRICAL CODE HANDBOOK (THIRD EDITION)—*By Arthur L. Abbott. Published by McGraw-Hill Book Co., Inc., 330 West 42nd St., New York, N. Y. 547 pages 5x7½ in.; illustrated; tables; fabrikoid covers. Price $3.*

In the United States, the National Electrical Code has become a minimum standard for electric-wiring requirements, but interpretation of the Code for the countless conditions under which it is used is not always a simple matter. The purpose of this book is to enable electrical workers to grasp readily the general plan, scope and intent of the 1935 Code requirements. It presents a more or less detailed discussion of rules where something of value could be contributed to make practical application of the rules clear and easily understood. Many illustrations help.

A word-for-word reprint of the Code is not included, but all its requirements are stated, with some rules reworded for clarity. Effort has been made to group all rules on one subject together. Under the grouping adopted, Code provisions are divided into five parts: definitions of terms; rules specifying what types of wiring are approved under given conditions; materials and apparatus; general requirements applying to all wiring systems; and special cases. All tables containing data to which inspectors, contractors and engineers constantly refer have been grouped together in the last chapter.

Professional Engineers

THE PROFESSIONAL ENGINEER (1936)—*By E. L. Brown, Published by Russell Sage Foundation, New York, N. Y. 86 pages. 5x8 in. Price, 75 cents.*

One of the proposed series dealing with the present status of certain established or emerging professions in the United States, this monograph discusses the evolution of professional engineering. It is divided into sections under the following headings: Engineering Educaton, National Association, Number of Engineers and Demand for Their Services, Salaries of Engineers, Trends in Engineering. It contains nine tables and a diagram, and is the best discussion thus far published on the general problem involving the professional engineer.

National Economics

RICH LAND, POOR LAND (1936). *By Stuart Chase. Published by Whittlesey House, a division of McGraw-Hill Book Co., Inc., 330 West 42nd St., New York, N. Y., 361 pages, 6x9 in. Price $2.50.*

This is a study of waste in the natural resources of America, a moving, compelling story of what we had and what we have wantonly done with it. Before the white man, America was luxurious with forests, prairie grass and limpid brooks and rivers, a land rich in bird, fish and animal life, a country of enormous mineral wealth. We have made ourselves comfortable, but have laid the country waste. We have laid the land bare to erosion, dust storms and floods, polluted the streams, exploited mineral resources—in fact have been busily sawing off the limb on which we sit.

Mr. Chase explains all this, then shows what we can do about it. If you think about the future at all, this book will give you real cause for thought. Very readable and informative.

Motor Control

CONTROL OF ELECTRIC MOTORS (1936)—*By P. B. Harwood, Engineering Supervisor, Cutler-Hammer, Inc. Published by John Wiley & Sons, Inc., New York, N. Y., and Chapman & Hall, Ltd., London, England. 390 pages, 6x9 in. 188 illustrations, several tables. Clothboard covers. Price $4.50.*

Proper control equipment is an essential part of every successful electric-motor application. Unfortunately, a technical literature has not been made available on control equipment comparable with its importance. This book is of such a character that it will help a lot to fill a long-felt need for more information on this subject. Written by a control engineer of long experience, it is filled with good practical information on control problems and equipment for solving them.

The first chapter outlines all the things that must be considered before selecting a control. Then follows seven chapters on d.c. motor controllers that deal with manual and automatic types, motor characteristics, relay, accelerating methods, dynamic lowering, etc. Controls for a.c. motors are covered in three chapters. The remainder of the book is devoted to pilot devices and accessories, brakes, wiring diagrams, resistors, electronic devices and construction of control apparatus. A large part of the treatment is void of mathematics, so that the material may be used by practical electricians as well as engineers.

Handbook

HANDBOOK OF ENGINEERING FUNDAMENTALS (1936). *Edited by O. W. Eshbach, E.E., M.S., with 40 contributors. Published by John Wiley & Sons, Inc., 440 Fourth Ave., New York, N. Y., 1081 pages, 6x9 in. Illustrated. Flexible fabrikoid covers. Price $5.*

This is No. 1 in the revised Handbook Series of this publisher, to contain also Kent's "Mechanical Engineer's Handbook," broken into two parts ("Power" and "Design & Shop Practice") and Pender's "Handbook for Electrical Engineers," also in two parts ("Electric Power" and "Communication & Electronics"). It contains basic mathematics, physics and chemistry.

Its sections deal with mathematical and physical tables, units, standards, theoretical mechanics, strength of materials, fluid mechanics as applied to hydraulics and aerodynamics, thermodynamics, electric units, magnetic and dielectric circuits, chemical tables, industrial chemistry, principles of light and acoustics, meteorological phenomena, properties of materials in manufacture and use, elementary legal aspects of contractual relations.

Trimmed pages are 5½x8⅝ in., with somewhat larger type and illustrations than are customary in books of this type. Tables also are clean and clear. Pages and illustrations are numbered by section rather than consecutively, to this reviewer an unhandy method, but otherwise treatment, both from the standpoint of readability and of content, is of a high order.

BRIEF REVIEWS

PAPERS PRESENTED AT THE SECOND ANNUAL SHORT COURSE IN COAL UTILIZATION AT THE UNIVERSITY OF ILLINOIS, JUNE 11-13, 1935. *Vol. 34, No. 18, of the University of Illinois Bulletin; a 163-page heavily illustrated paper-bound bulletin. Price, $1*—Available from Engineering Experiment Station, University of Illinois, Urbana, Ill.

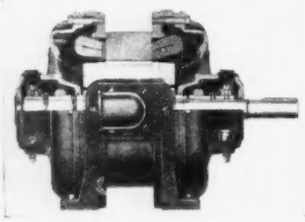
PAPERS PRESENTED AT THE FIRST ANNUAL CONFERENCE ON AIR CONDITIONING AT THE UNIVERSITY OF ILLINOIS, MAY 4 & 5, 1936. *Vol. 34, No. 13, of the University of Illinois Bulletin. Published as Circular No. 26 of the Engineering Experiment Station, and available from the station, at the University of Illinois, Urbana, Ill. Price, 50 cents*—A 154-page, paper-bound report of the papers on a wide variety of air-conditioning subjects. Heavily illustrated.

A STUDY OF THE REACTIONS OF VARIOUS INORGANIC AND ORGANIC SALTS IN PREVENTING SCALE IN STEAM BOILERS. *By Frederick G. Straub. Bulletin No. 283 of the Engineering Experiment Station, University of Illinois, Urbana, Ill. 118 pages, paper cover. Price $1*—Report of an investigation by the Engineering Experiment Station in cooperation with National Aluminate Corp. The inorganic section describes scale-prevention by the use of various inorganic salts. The second part describes results by the use of organic material, such as so-called tannin extracts. Some copies available free.

ANALYSIS OF FLOW IN NETWORKS OF CONDUITS OF CONDUCTORS. *By Hardy Cross. Bulletin No. 286 of the Engineering Experiment Station, University of Illinois, Urbana, Ill. 32 pages, paper covers. Price, 35 cents*—These are methods of successive corrections which are sufficiently rapid to make methods useful in office practice. Some copies available free.

MANUAL OF SMOKE AND BOILER ORDINANCES AND REQUIREMENTS IN THE INTEREST OF SMOKE AND AIR POLLUTION REGULATION AND FUEL COMBUSTION. *An official publication of the Smoke Prevention Association. Copies available from Frank A. Chambers, Chief Smoke Inspector, Chicago, Ill., who is secretary-treasurer of the association*—An 80-page bulletin including Ringleman charts, code for rating steel heating boilers, requirements for smokeless settings, questions and answers on smoke prevention, excerpts from papers read at conventions, etc.

WHAT'S NEW IN PLANT EQUIPMENT



RIVETED-FRAME MOTORS

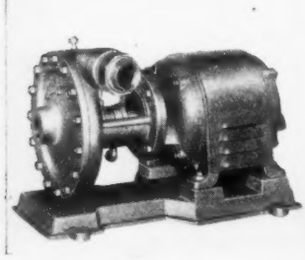
SQUIRREL-CAGE polyphase induction motors in riveted-frame sizes of 1 to 15 hp. at 1,800 r.p.m. Variety of electrical and mechanical modifications incorporate improvements in stator-coil insulation, frame construction and other design elements. Units can be used interchangeably for many types of power supplies and for various applications, since types include open, sleeve- or ball-bearing, inclosed, inclosed fan-cooled, splash-proof, vertical motors, etc. Illustrated in cutaway view of open sleeve-bearing type. Random-wound stator coil winding has fused connected joints instead of soldered. Special insulating material eliminates need for taping end windings and producing insulation assembly with high resistance to moisture and other common deleterious influences. Malleable-iron end frames; cast-iron end shields. 2-part conduit boxes. Ball bearings provided with pressure grease fitting and relief plug; sleeve bearings equipped with oil-filler gage on either side of housing. Easily accessible. Bulletins GEA-2345, GEA-1326C, GEA-1341C, GEA-1538A, and GEA-1619B.

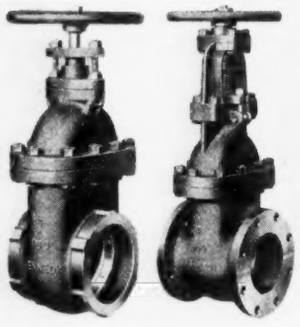
General Electric Co., Schenectady, N. Y.

BOILER-FEED PUMP

THIS pump handles feed water against either low or high pressure at high temperature. Requires no maintenance or adjusting and can be fitted for automatic operation if desired. Sizes up to 3 in. Guaranteed not to show efficiency loss for three years.

Becker Pump Co., Inc., 1447 Park Ave., Emeryville, Calif., or American District Steam Co., North Tonawanda, N. Y.





WEDGE-GATE VALVES

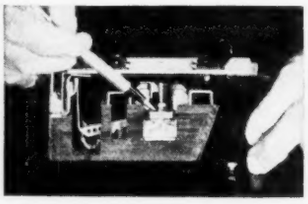
STANDARD iron-body valves of oval section with well-rounded corners, heavy flanges and bolts, and ribbing on flanges of larger flanged-end valves and at yokes and caps of outside screw-and-yoke types. No studs, and all bolts have nuts above flanges and with ample room for standard open-end wrench. Special provisions to facilitate repacking. Stuffing-box bolts and nuts rust-proofed. Heavy bronze bushings where stem passes through cast-iron parts, as of yoke cap, packing gland and stuffing box. Screwed - end valves have round ends for best distribution of metal and lugs for pipe or chain wrench. Disks reinforced with posts, self-draining in any position and reversible and interchangeable. All standard sizes from 1½ to 60 in. for steam working pressure of 150 lb. and water working pressures of 200 lb.

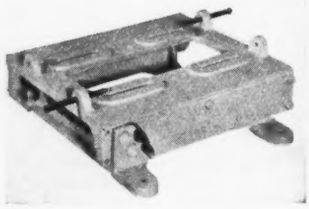
Kennedy Valve Mfg. Co., Elmira, N. Y.

MULTI-BREAKER LOAD CENTER

THIS compact unit designed so that each contact can interrupt 5,000 amp. at 115 volts, 60 cycles, without objectionable noise or flash. Unit is a low-priced substitute for 115/230-volt a.c. fuse and switch combinations and conventional individual a.c. circuit breakers having branch circuits from 15 to 35 amp. Illustrated is a close-up of the contact mechanism of one pull, exposing common contact in center, one floating contact lever and bi-metal overload trip at extreme left. Developed by Square D and Westinghouse engineers.

Westinghouse Electric & Mfg. Co., East Pittsburgh, Pa.





SOUND-ISOLATING MOTOR BASE

"SOUND-PRUF" base for motors, fans, blowers, etc., is a floating platform supported by resilient rubber balls set in recesses between parallel flanges. Number of balls can be adjusted to suit weight and operating conditions. Maintains motor alignment for any reasonable belt tension, thus especially suitable for belt drives. Types for other applications also. Motor-support platform slotted and has adjusting screws for belt adjustment. Fits NEMA standardized dimensions, also has universal bases for fractional-horsepower motors. Insulating material should last five to eight years, since balls are protected from oil, and are readily replaceable when worn.

W. D. Fabling Co., 2043 Sacramento St., Los Angeles, Calif.

STEAM-JET EJECTORS

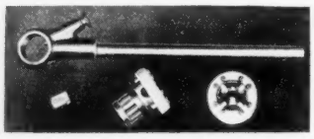
FOR vacuums from a few inches of mercury to within less than 1 millimeter of perfect vacuum, these steam-jet ejectors are available in single or multiple units. Can be used in condensors for power plants and in various process work. Bulletin W-295-B2 contains chart showing economic ranges of volume and capacity for standard, single and multi-stage units, together with a saturated vapor-pressure curve.

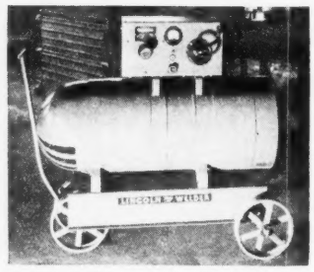
Worthington Pump & Machinery Corp., Harrison, N. J.

RATCHET THREADER

No. 2 open ratchet ⅛- to ¾-in. is a low-cost unit. Die heads have oil holes and chip clearance and can be inverted for threading close to wall. Dies easily removed for resharpening. Tool made of air-furnace malleable iron. Dustproof finished. Vanadium alloy-steel dies, right- or left-hand.

Beaver Pipe Tools, Inc., Warren, Ohio.





DUAL ARC CONTROL WELDER

"SHIELD-ARC SAE" welders have new arc control which makes possible adjustment of both arc heat and penetration in a continuous sequence of fine increments. Claimed to give uniformity of performance at every control setting. Otherwise similar to earlier "Shield Arc" models, having independent excitation, laminated magnetic circuit, all-purpose meter, polarity reversing switch, no-voltage motor protection, etc. Shorter wheel base. Types and ratings incline a.c. motor-drive, 200, 300, 400 and 600 amp.; d.c. motor-driven, 300, 400, and 600 amp.; generator for belt or couple service, 200, 300, 400 and 600 amp.; engine-driven, 200, 300 and 400 amp.

Lincoln Electric Co., Cleveland, Ohio.

CLOSE-CONTROL HEATING SYSTEM

SAVINGS of 15% and more in use of steam after boiler room are claimed for new heating system with "Radiostat" control for low-pressure jobs for fairly large buildings. Also 42% average saving claimed in steam production costs through lower-priced coals, smokeless operation and increased efficiency, using automatic underfeed stokers. Unit governs firing through electronic tubes actuated by outside temperature. Heat elements and master control locked after installation. Only moving part motor-starting relay. Folders 1517 and 1518.

Link-Belt Co., 2418 West West 18th St., Chicago, Ill.

ALLOY STEELS

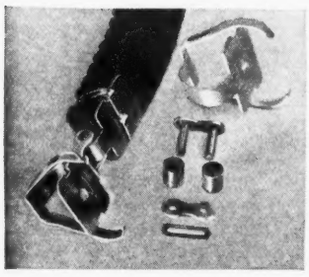
"USS CARRILLOY" is new trade designation to show trademark for entire group of Carnegie-Illinois alloy steels.

Carnegie-Illinois Steel Corp., Pittsburgh, Pa.

A.C. WELDERS

NEW line of low-priced welders to supplement "Wonder Arc" type in use for some years.

Miller Electric Mfg. Co., Appleton, Wis.



V-BELT COUPLER

"GRIP - FLEX" roller - bearing coupling available in all standard sizes from A to E in a variety of types to suit belt, strength and size. Other sizes to order. Anchor plate surrounds belt ends so that no strength is lost in attaching coupling. Also trailer pin relieves strain of heavy loads and shock. Side plates and replaceable roller bearings. Friction pin is self-lubricating rawhyde type. Freedom from vibration and quiet operation over sheaves claimed. Permits belt to be cut to size from roll stock. Bulletin 36.

Shippert Mfg. Co., Dept. P, 414 South Galena Ave., Dixon, Ill.

FLEXIBLE FIREBRICK WALL CONSTRUCTION

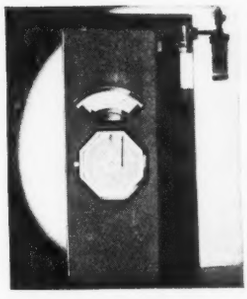
INDIVIDUAL expansion joint for each firebrick in furnace lining. "Robinson" joints consist of box-like casings in which refractory bricks are encased. Claimed to overcome pinching, spalling and checking, as well as cracking and bulging of walls. Structure is laid up dry, no high-temperature cements or fireclays being used. Sections can be repaired without fracturing some other part of structure. Furnaces can be used immediately after masonry is completed. Joint material is chemically treated asbestos, providing usual 3/16-in. expansion allowance per foot, although this can be varied to suit particular refractories. Five sizes of brick are covered.

Continental Engineering Co., Inc., 64 Hamilton St., Paterson, N. J.

DRAIN AUGER

FOR removing obstructions from floor drains, oil lines, water lines, process lines, goosenecks, elbows, etc. Flexible tube is fed into obstructed passage, and unit bores, twists and forces through.

Sanitation Tool Mfg. Co., Chicago, Ill.



CO_2 METER

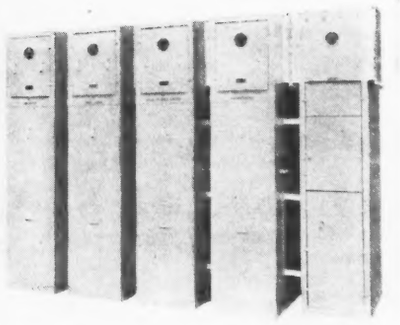
PERCENT CO_2 in flue gas is measured by Orsat method and meter is built to duplicate, mechanically, this chemical analysis. Driven by fractional-horsepower motor and requires no water. 14-in. Hg. mercury suction to avoid possibility of stoppage in gas line. Large caustic tank holds enough potash to last 4-6 mo. Temperature variations do not affect meter readings. Gas-line filter removes all CO_2 from gas before it reaches analyzer. Permanent continuous pen-line record may be read directly in % CO_2, and arrangements of indicators and recorders may be made to fit any requirement. Related factors, such as steam flow, temperature, draft, pressure, etc., may be combined on one circular chart. Minimum moving parts. Data Book 403.

Republic Flow Meters Co., 2240 Diversey Parkway, Chicago, Ill.

ROUND-CHART METERS

RECORDING voltmeters and ammeters in wall, switchboard, flush-panel, pole, and portable models. All have moisture, fume and dustproof aluminum alloy case. Measuring element is separate and can be replaced easily by removing three screws from mounting. Pen arm inverted and pivoted at top so that pen pressure against chart is controlled by gravity. Micrometer zero adjustment and replaceable chromium-plated tip on pen arm. 2-drop, fine-bore platinum-point fountain pen developed for these units. Spring-driven or electric Telechron clock. Bulletin No. 436.

Bristol Co., Waterbury, Conn.



METAL-CLAD SWITCHGEAR

ILLUSTRATED is a 4-unit, 3-pole, 800-amp., solenoid-operated oil circuit breaker with current transformers, relays and plus disconnectors with interlocks, all in one assembly. Main bus in top compartment. Right-hand or fifth unit houses three potential transformers and 3-pole group-operated disconnecting switch interlocked with door. Fuses mounted on switch frame are equipped with limiting resistors. 7.5-kv. unit.

Delta-Star Electric Co., Chicago, Ill.

PORTABLE VOLT-WATTMETER

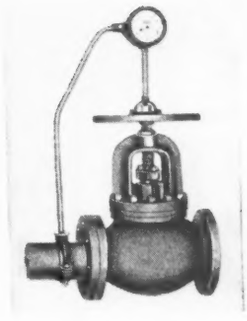
COMBINATION volt - wattmeter to suit Type AP-9 series of instruments. Either rating may be used by throwing switch on top of instrument. Over-all accuracy ¾% of full-scale valve. Magnetic damping. Permaloy moving vane, shielding from stray magnetic fields.

General Electric Co. Schenectady, N. Y.

DIESEL ENGINE

TYPE S, vertical, 4-cycle, single-acting, solid-injection diesel is a medium-speed heavy-duty, continuous-service unit. Design is similar to that of this company's locomotive engines. 3, 4, 5, 6 or 8 cylinders for ratings of 150 to 460 hp. Full enclosure, force-feed lubrication, adjustable or replaceable wearing parts, easy access, straight-line design, low over-all height, high-velocity water circulation in a directed path, speeds of 514 to 600 r.p.m.

Ingersoll-Rand Co., 11 Broadway, New York, N. Y.



VALVE-POSITION INDICATOR FOR VERTICAL STEMS

MODEL 4-VS Tejax adjustable valve-position indicator shows exact setting and permits easy return to that setting without guesswork. Will read as close as 1/100 turn. Small hand counts number of turns while large hand indicates fractions of turn. Can be attached to any valve in service without breaking into line. Dial 3⅜-in. For valves with handwheels of 6 in. or over. Also Model 2-VS for smaller valves, which has special handwheel to replace regular valve wheel and has 2½-in. dial.

Tefft-Jackson, Inc., Providence, R. I.

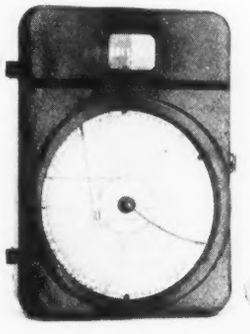
UNIT HEATER

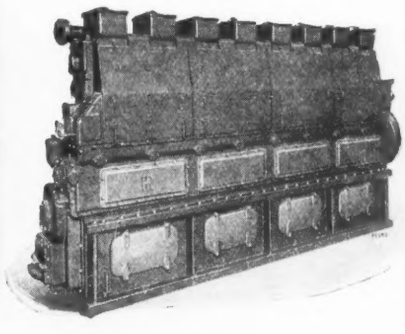
"GRID" heater in four new sizes with all cast-aluminum heating sections bonded with steam chamber to prevent electrolysis. Capacities at 2-lb. steam pressure and 60-deg. temperature are: No. 515—56,750 B.t.u. with 1,290-c.f.m. air volume at fan; No. 520—97,500 B.t.u. with 2,500-c.f.m. air volume; No. 525—158,500 B.t.u. with 4,200-c.f.m., and No. 530—248,000 B.t.u. with 5,300-c.f.m. air volume at fan.

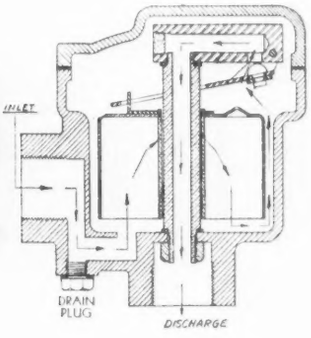
Unit Heater & Cooler Co., Wausaw, Wis.

SMALL STEAM TRAP

FOR small capacities, such as on unit heaters, steam tables, sterilizing equipment, radiators, drips on steam mains, etc., "Super-Silvertop No. 10" is available for pressures from 0 to 125 lb., and a wide range of capacities. Valve and seat are hard chrome alloy. Bucket 1-







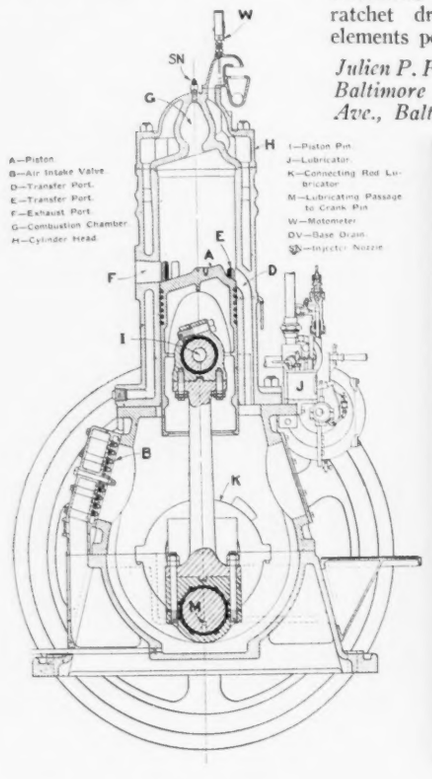
piece copper. Working parts stainless steel. Bucket guided by hexagonal tube as on larger traps of same make. Unit does not leak steam, hence operates on vacuum. No strainer necessary. Inspected, cleaned or disassembled without removing trap from line.

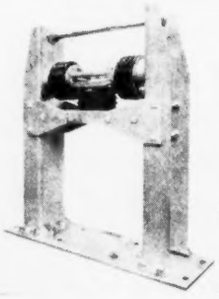
V. D. Anderson Co., 1934 West 96th St., Cleveland, Ohio.

2-CYCLE HEAVY-DUTY DIESEL

TYPE KD cold-starting mechanical-injection engine can rotate in either direction and is rated at 1,000-ft. altitude. 257 r.p.m. to suit direct-connected generators. Two flywheels suitable for driving belts if desired. Forged, heat-treated crankshaft. Gray cast-iron base. Main journals chain lubricated. Removable-shell main bearing. Trunk piston. Detachable gray-iron cast cylinder. 1-piece cylinder head combining head and combustion chamber, thus enlarging water jacket and eliminating one gasket. Cylinder head combination as compression-relief valve of combination pipe which also acts as an automatic relief valve. Readily accessible fuel pump which can be stopped individually while unit is in operation. Centrifugal enclosed-type governor mounted in crankcase which shortens and lengthens fuel-injection pump stroke proportional to load. Heavy forged marine-type connecting rods. Piston speed 771 f.p.m. 1 to 6 cyl. with ratings of 50 to 360 hp.

Anderson Engine & Foundry Co., Anderson, Ind.





BUS SUPPORT

FOR insulating and supporting bus bars on which very high short-circuit stresses may occur. Insulators are interchangeable, and clamps are roller type to permit bus expansion.

Delta-Star Electric Co., Chicago, Ill.

ADJUSTABLE WRENCHES

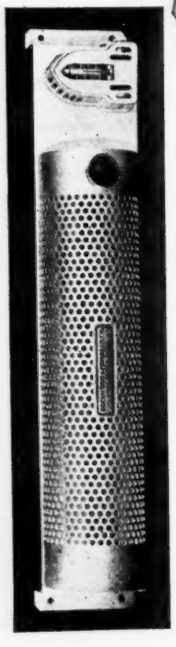
SQUARE shoulders on movable-jaw shanks to overcome wedging and spreading and provide positive bearing. "Adjustable" unit drop-forged from special carbon steel. "Superjustable" wrenches forged from chrome-alloy steel to give greater strength with lighter weight. Chromium plate with polished heads and satin-finished handles. Both types in five sizes, 4 6, 8, 10 and 12 in. Bulletin.

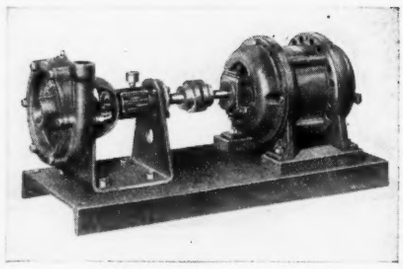
J. H. Williams & Co., 75 Spring St., New York, N. Y.

BAROGRAPH

MICROBAROGRAPHS show minute fluctuations of barometer as continuous inked record. Recording scale expanded in ratio of 2½ to 1. Jeweled clock movement which revolves ratchet drum, while pressure elements position recording pen.

Julien P. Friez & Sons, Inc., Baltimore St. & Central Ave., Baltimore, Md.





SMALL CENTRIFUGAL PUMP

PRESSED-STEEL frame and simple design results in fewer wearing parts, lower cost and lower maintenance cost, according to claims. Direct motor drives or pulleys for belt drives. Motor sizes from 1/3 to 3 hp., delivering 10 to 130 g.p.m. with heads from 10 to 100 ft. Shaft supported by two ball bearings in dirt-proof and moisture-proof housing. Standard, all iron or all bronze fittings. Bulletin W-310-B5.

Worthington Pump & Machinery Corp., Harrison, N. J.

GASKET CUTTER

WILL cut gaskets from asbestos, superheat sheets, rubber sheet packing, cloth inserted sheet packing, felt, cork, cardboard, cloth, duck, rubber, etc. Furnished complete with six double-edged cutting blades of special-tempered steel adjusted for any desired thickness from 1/100 to ⅝ in. thick. Adjusted through slotted screws at cutter head. Unit will cut gaskets from 1 to 36 in. in diameter.

Allpax Co., Inc., Mamaroneck, N. Y.

AUTOMATIC SPACE HEATER

FOR valve houses on dry-pipe sprinkler systems, this electric heater consists of heating element, control thermostat, thermometer, pilot light, and 3-in. outlet box on pressed-metal frame. Metal guard protects heating element, and back is insulated. Standard model rated 500 watts, 110 volts a.c. or d.c. Special models for 220- and 440-volt a.c. or d.c. Overall length 27⅝ in., width 5 in., depth 5¼ in. Thermostat adjustable to hold heat anywhere between 35 deg. and 60 deg. F. Unit also can be used to heat pump houses, pipe enclosures, etc. Illustrated at left.

Rockwood Sprinkler Co., Worcester, Mass.

FUSE CLIP CLAMP

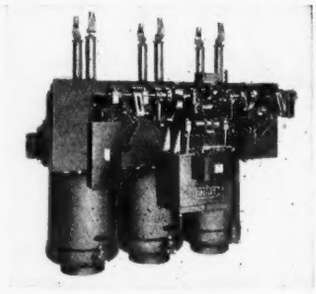
NEW principle of applying pressure to blades of fuse clips or switch clips. Steel clamping ring is forced over outside of jaws, exerting high pressure against fuse or switch clips, accomplished simply by turning knob. Grips all clipped equally irrespective of width. Cuts down resistance, prevents burning and pitting.

Ideal Commutator Dresser Co., 1025 Park Ave., Sycamore, Ill.

POCKET-SIZE INSTRUMENTS

TYPE AS-5 pocket-size voltmeters, ammeters and milliammeters incorporate new element with higher torque and improved characteristics. Overall dimensions 5½ x 3½ x 2 in., and weight 12 oz. Accuracy 1% of full-scale value. Magnetic damping, Permaloy moving vane, shielding from stray magnetic fields. Knife-edge pointer and mirror scale. On double- and triple-scale instruments, face-switch to change ratings without rewiring.

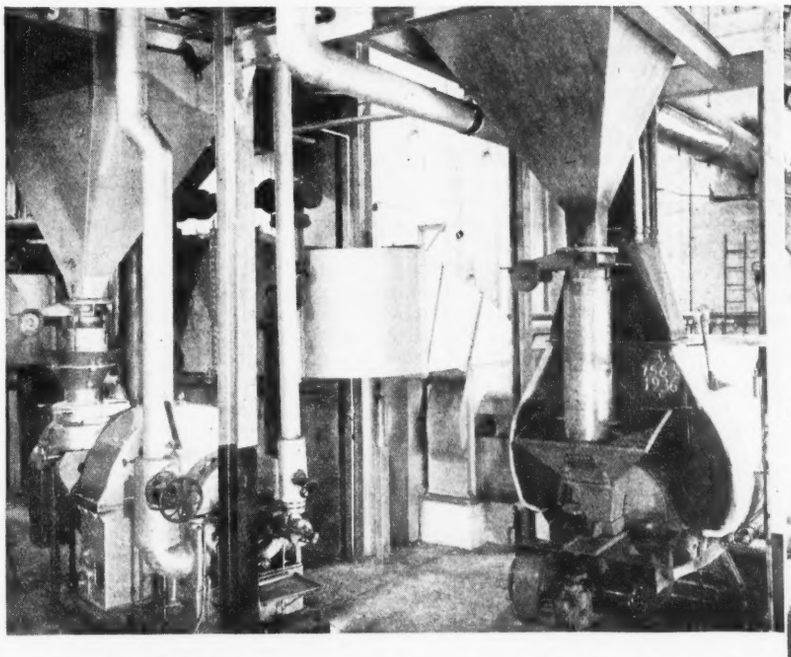
General Electric Co., Schenectady, N. Y.

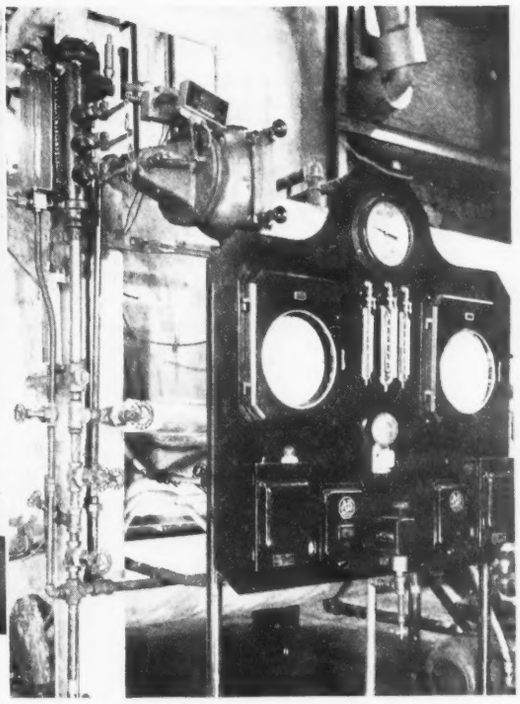


OIL CIRCUIT BREAKER

INDOOR FZ-220 station-type breaker with capacity from 500,000 to 2,500,000 kva., and voltage ratings from 15 kv. to 34.5 kv. Equipped with "Ruptors" — interrupting devices which afford quick clearing.

Condit Electrical Mfg. Co., Hyde Park Station, Boston, Mass.





PLANT of the MONTH

Small Boiler Saves $159 Every Week

MONEY SAVING through power modernization is an established policy at the plant of Taylor Instrument Companies, Rochester, N. Y. A major change was made in 1931, when a roomful of stoker-fired h.r.t. boilers were replaced by two modern steam-generating units and their auxiliaries. These are 5,169-sq. ft. identical Connelly (now Foster-Wheeler) water-tube boilers, each capable of generating 45,000 lb. of steam per hr. at 415 lb. and 650 deg. F. Pulverized coal is fired by unit mills, each dual driven by turbine and motor. Other equipment installed in 1931 includes a deaerating heater, coal-handling equipment, and modern control and instruments. This steam-generating plant, pictured and described in June, 1933 *Power* (pages 292-293), has given completely satisfactory service and is saving yearly over the old equipment about $6,250 in coal alone.

The latest addition, placed in operation Sept. 16, this year, is of particular interest because it adds a small stoker-fired marine-type boiler to the large pulverized-coal-fired units for further substantial savings. With this addition, the Taylor setup amounts to two complete and practically independent steam-generating plants in the same room—a high-capacity plant for work-day operation and a small automatic plant for nights and week-ends when the load is too low for efficient operation of the large plant. Under the new arrangement the big units are shut down every night and every week-end (Saturday and Sunday) during the Spring, Summer and Fall, leaving the small boiler to supply the small steam requirements of these periods.

A few weeks ago one of *Power's* editors inspected the installation and talked with R. A. Taylor, plant engineer, and Wm. Gessner, power engineer, and made the accompanying photographs.

Mr. Gessner kindly took exceptional pains to explain that the selection of a stoker-fired unit does not imply any dissatisfaction with his pulverized-coal installation, which is very efficient on day loads and has given practically no trouble. The point is that there was a special type of job to be done—one particularly suited to the self-contained, automatic type of unit selected.

The new unit, shown in Figs. 1, 3 and

Fig. 1—New unit stands at right of large pulverized-coal-fired boilers. Existing conveyor supplies the 5-ton bunker feeding to stoker hopper. 2-hp. motor (lower right) drives f.d. fan (lower left) and worm (lower center) of stoker drive

Fig. 2—Control and instrument board. Top: Taylor flue-gas thermometer; Upper row (left to right); Taylor steam-flow meter; gages for draft in furnace, stack and last pass; Taylor feed-water temp. recorder; Center: Low-water alarm bell (duplicated in watchman's office); Lower row: Stoker switch and automatic control; excess-pressure shut off for stoker; feed-pump switch and automatic control. Behind board are Kisco float-type feedwater control and Reliance water column with high and low water alarm

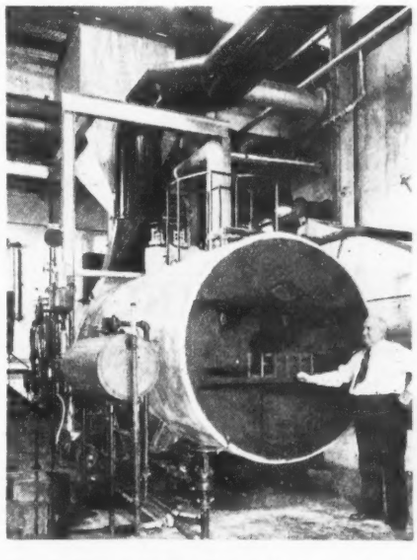


Fig. 3—Wm. Gessner, chief engineer, stands behind the new boiler. Returns tank at left supplies automatic feed pump below and is equipped with a float-operated make-up valve. A Kisco "double checker" on the tank shuts down feed pump and stoker if tank goes dry

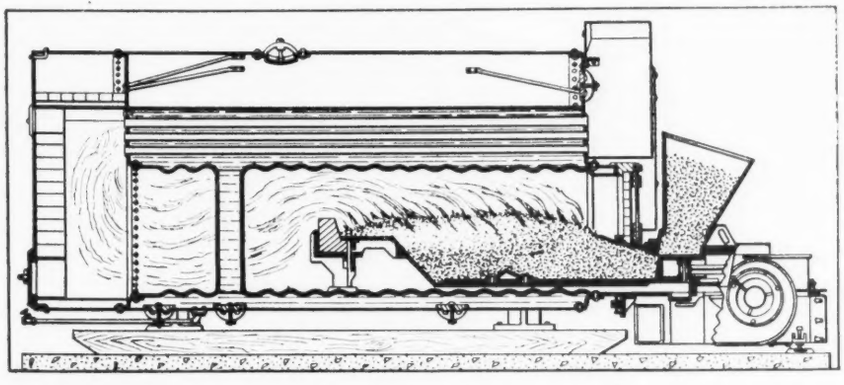


Fig. 4—Cross-section of marine-type boiler and automatic stoker. Saving will pay the complete cost of $5900 (including all auxiliaries, controls, instruments, piping and installation) within 1 year

4, is a 600-sq.ft. Leffel, Scotch-marine-type boiler, fired with an automatic underfeed stoker of the same make. Maximum continuous steaming capacity is about 4,000 lb. per hr. The stoker has a single coal-fired plunger and a reciprocating distributor plate. Stoker gearing is enclosed dust proof and runs in an oil bath. A single 2-hp. motor drives both stoker and forced-draft fan.

The boiler (Fig. 4), is "dry back," with a cleaning door at the bottom of the combustion chamber. A vertical circulation tube permits water to flow up through the internal furnace from the bottom, thus avoiding the cold bottom sometimes found with marine-type boilers.

Control of fuel and air is completely automatic. Both fan and stoker stop automatically for either over pressure or low water. Under such conditions it is impossible to start up the boiler even under hand control. The various control elements are shown in the photographs and identified in their captions.

Except in winter, the chief applications of steam are for wood drying and heating of the varnish room and for overtime work on processes in several departments. Formerly the large boilers required 11 tons of coal for Saturday and Sunday operation—also the services of a skilled engineer. The new unit will handle this week-end load on 400 lb. and can be cared for by a fireman who also has watchman duties. The saving in a single average week-end is $114.24, figured as follows:

Coal, 10.4 tons @ $6.00	$62.40
Labor, 72 hr. (1½ × 48) @ 72c.	51.84
Total	$114.24

For each night run the saving is $9 in coal (1½ tons), with no saving of labor. This gives a total weekly saving of $159 for Spring, and Fall, and in summer when kilns are operated.

The cost of boiler and stoker was $3,900. Installation, plus the rather elaborate assembly of valves, instruments and controls, and a special process-steam connection, brought the total to $5,900. This will be paid for by savings in about one year.

POWER LINES

Power Show to be Largest Since 1929

Latest reports on the Twelfth National Exposition of Power and Mechanical Engineering, to be held at Grand Central Palace, New York, N. Y., Nov. 30 to Dec. 5, indicates that three floors will be occupied, and that exhibits will make this show the largest since 1929. A wide variety of equipment, including all types of power units and auxiliaries, will be shown.

Collusive Bidding Charged by Trade Commission

Collusive bidding and uniform price maintenance on turbo-generators and condensers has been charged in a complaint by the Federal Trade Commission. The main companies are General Electric Co., Westinghouse Electric & Mfg. Co., Allis-Chalmers Manufacturing Co., Elliott Co., Worthington Pump & Machinery Co., Ingersoll-Rand Co., C. H. Wheeler Mfg. Co., Foster-Wheeler Corp., and Ross Heater & Mfg. Co. They are charged with entering a price-fixing agreement in 1933 and are described as a group so powerful that they are able to control all business in these products, the principal purchasers of which are public utilities and municipal state and federal governments. The complaint alleges that this price-fixing agreement embraces uniform performance guarantees and adherence to pricing sheets which bear no relation to individual costs of manufacture, also that these companies submit identical bids for generators and condensers, and also for extra, and that they take disciplinary action against any one of the group who fails to abide by the agreed prices.

Acetylene Association to Meet in St. Louis

The 37th Annual Convention of the International Acetylene Association is to be held at the Hotel Jefferson, St. Louis, Nov. 18, 19 and 20. It will include five technical sessions and an inspection trip to Midwest Piping & Supply Co., Inc. Included in the program are these papers of particular interest to power engineers:

"Welding of Cupro-Nickels and Silicon Copper Alloys," by I. T. Hook, engineer, American Brass Co.

Demonstration of welding and cutting by special demonstrators, including materials, oxyacetylene welding, testing, trade practices, cutting, etc.

"Application of Welding and Cutting in Heavy Construction Industries," by Col. Charles H. Ellaby, civil engineer, U. S. Engineers Dept.

A Welding and Cutting Round Table, including welding high- and low-alloy steels, safety codes, welding design and construction, qualification and training of operators, power stations.

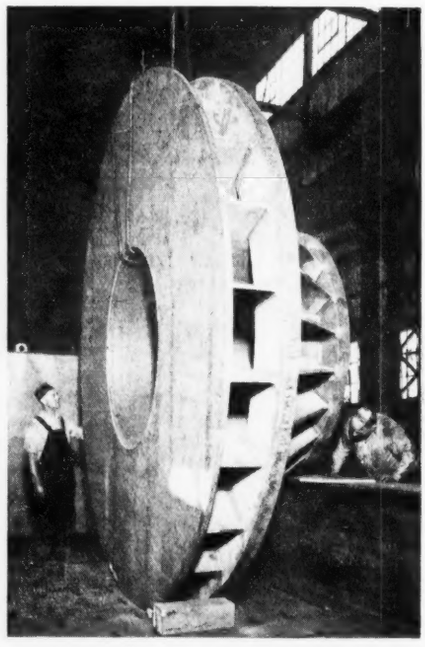
"Power Plant Piping," by Wilson Benoist, assistant chief engineer, Anheuser-Busch Brewing Co.

"Cutting the Steel Pipe for Pressure Vessels."

"Welding of Pipe Lines for Oil and Gas."

"Power Round-Ups"

Dodge Mfg. Co., Mishawaka, Ind., is giving a series of demonstrations in large industrial centers called "The Dodge Power Round-up." The New York demonstration held in the Pennsylvania Hotel Oct. 14, was in reality a miniature power show showing the company's various kinds of mechanical power-transmission equipment in operation and supplemented by an illustrated lecture on bearing, shafting, rope drives, belts, gears, variable-speed transmission, clutches, and other equipment. One example was in the company's own shop where 88 motors totaling 451.5 hp. and costing $16,286.48 would have been required if individual drive had been used. By using a combination of individual and group drive, the motors were reduced to 16 with a total connected load of 143.5 hp. and costing $9,505.33 installed, a saving of $6,781.15. It was pointed out that the only insurance of geting the right drives is a survey of the project by a competent power-transmission engineer.



ROTOR LIFTER

This all-welded rotor attachment is designed to lift a weight of 600 tons and itself weighs 19. It will handle the 500-ton rotors being installed at Bonneville Dam. Built by Bethlehem Steel Co. for Harnischfeger Corp., it is 12½ ft. in diameter and 12 ft. tall. It is fastened to the rotor being lifted by long bolts, and its forged upper stem mounts in a swiveled crosshead of the main lifting beam, carried by roller bearings.

MEETINGS

American Society of Refrigerating Engineers—*32nd annual meeting, Hotel Pennsylvania, New York, N. Y., Dec. 2-4. D. L. Fiske, secretary, 37 W. 39th St., New York, N. Y.*

International Acetylene Assn.—*37th annual Convention, Jefferson Hotel, St. Louis, Mo., Nov. 18-20. Headquarters: 30 East 42nd St., New York, N. Y.*

Refrigeration Service Engineers' Society—*Third annual convention and exhibit, Hotel Gayoso, Memphis, Tenn., Nov. 11-13. Further information from H. T. McDermott, national secretary, 433 North Waller Ave., Chicago, Ill.*

Society for the Promotion of Engineering Education—*Fall meeting, Middle Atlantic Section, Columbia University, New York, N. Y., Dec. 5. All engineers interested in education are invited.*

Twelfth National Exposition of Power & Mechanical Engrg.—*Grand Central Palace, New York, N. Y., Nov. 30-Dec. 5. In charge Chas. F. Roth, International Exposition Co., Grand Central Palace, New York, N. Y.*

Power Margin High in New England

Facing an increased peak load late this fall, the Boston Edison and New England Power Association systems expect to have a net surplus capacity of about 20% for 1937 requirements, according to Pres. Frank D. Comerford of the former organization shortly before *Power* went to press. Combined generating capacities of these closely interconnected systems total about 1,000,000 kw. Assuming 100,000 kw. as a reserve against temporary "outage" of equipment, in 1935 there was a net reserve of nearly 35% over their combined peaks. Mr. Comerford declared that no danger of a power shortage in that area appears to exist. Active engineering studies, however, are being brought up to date in relation to comparisons of programs for the installation of new equipment in present stations, improvement of efficiency of older units, and the superposition of high-pressure boilers and turbines on lower-pressure plants now in operation.

Fuel Engineers Meeting Held in Cincinnati

All phases of smoke problem received attention in Cincinnati, October 5, at the sixteenth fuel engineers' meeting, Queen City Club, under sponsorship of Appalachian Coals, Inc. There were a number of talks on various phases of the smoke problem, including some discussion of sulphur and the effect of its oxide, as well as the effect of soot and dirt. William G. Christy, smoke abatement engineer of Hudson County, N. J., brought out that King Edward I, of Great Britain, in 1307, instructed a commission "to inquire of all such who burnt sea-cole in the city or parts adjoining, and to punish them for first offense with great fines and ransoms, and for the second offense to demolish their furnaces." Several speakers pointed out the extreme importance of better combustion practices sponsored by coal suppliers in cutting down the deleterious effects of smoke.

Welding Society Meets in Cleveland

As a part of the National Metal Progress Exposition in Cleveland, Oct. 19 to 23, the American Welding Society held its seventeenth annual meeting at the Hotel Cleveland. Thirty papers were presented and a number of inspection trips scheduled. Henry Metcalf Hobart, consulting engineer of General Electric Co., was awarded the Samuel Wylie Miller Memorial Medal for his outstanding services in the development of engineering research.

Included in the papers was "When and How Silver Solders are Used," by R. H. Leach, manager of Handy & Harman, Bridgeport, Conn. He pointed out that silver soldering is no different in principle from soldering with plumbers' or tinsmiths' solder, but while ordinary solder melts at about 300 deg. F., silver solder (made of silver and copper and possibly some zinc), melts at 1,200 to 1,600 deg. It has greater strength, resistance to vibration and shock, resistance to corrosion, and ease of fabrication. It is possible to make a solder joint with a gap of only 0.0015 in. between the parts to be joined. In many cases the silver solder joint is invisible to the naked eye. Yet a silver-soldered assemblage of 1-in. brass pipe has withstood a water pressure of 4,300 lb. per sq.in. It is easy now to produce satisfactory joints with silver solder, and Mr. Leach pointed out in his paper a number of modern methods of making them.

In "The Effect of Low Temperature on the Tensile Impact Resistance of Some Iron, Steel and Welded Joints," Prof. Otto H. Henry, of Polytechnic Institute of Brooklyn, reports the results of tests on all types of welds in various metals at temperatures as low as 112 deg. F. Using a new and more accurate testing technique, Professor Henry determined that tensile impact values of welds in mild steel are in no sense brittle and are indeed but slightly inferior in toughness to mild steel at both normal and low temperatures. He also showed that bronze-welded joints are by no means brittle under shock, even at 112 deg. below zero. On oxy-acetylene welds in stainless steels, tensile impact values were very high as compared with mild steel, their toughness increasing at lower temperatures.

There were a number of other interesting papers, copies of which can be obtained by application to the Society at 29 West 39th St., New York, N. Y.

Power Problems in Air Conditioning

Considerable light was thrown upon the broader power problems of air conditioning at a recent conference of the Babson Statistical Organization, Wellesley, Mass., in an address by W. H. Carrier, chairman of the Board, Carrier Corp. Mr. Carrier pointed out that the supply of power and water are important operating matters after initial costs are considered, and that heat cannot be transferred without the expenditure of power in some form nor can heat be removed without some means of cooling. If the entire process were 100% efficient it would require more than 10 kw.-hr. of energy to produce 1 ton of ice. While in air conditioning the process is basically more efficient, it would still require about 60% as much power to produce the corresponding cooling effect.

In addition to the power load required for cooling effect, where fans, pumps and other auxiliaries are required for year-round operation, the total annual power cost is about double that of operating the refrigerating equipment alone. Year-round air-conditioning equipment in the larger installations costs about $250 per hp. of connected load. Mr. Carrier said that the user of purchased power for this service will annually pay the power company from $20 to $25 per hp. of connected load, so that in the end, considering the life or amortization period of the equipment, the power company will receive a greater return from air conditioning energy sales than the vendors of the apparatus. Fortunately the maximum power load comes in the summer when it is economically advantageous.

Additional Equipment Needed

With the great prospective growth of air conditioning, Mr. Carrier stated, additional power equipment will have to be provided either by the power companies or the larger users. In large projects, such as office buildings or groups of buildings for which air conditioning may be developed as a unit in the future, the same steam plant which is required to provide heat for winter may be utilized to provide power for cooling in summer. While this possibility has already been utilized to some extent, Mr. Carrier said that it would not become general practice until the power demand from air conditioning materially exceeds the reserve capacity of the

NO SMOKING ALLOWED

Combustion authorities and smoke abatement officials meeting at the 16th meeting of Appalachian Coals, Inc., Engineering Division, with smoke prevention associations, public service commissions, and representatives of the U. S. Bureau of Mines. Seated left to right: W. E. E. Koepler, Bluefield, W. Va., first vice president, Smoke Prevention Association of America; R. E. Howe, vice-president, and J. E. Tobey, manager, Fuel Engineering Division, Appalachian Coats, Inc.; Frank H. Lamping, executive secretary, Smoke Abatement League of Cincinnati; and John D. Battle, executive secretary, National Coal Association, Washington. Standing, left to right: Clifford Stegner, commissioner of buildings, Cincinnati, O.; William Culbert, chief smoke inspector, Nashville, Tenn.; William G. Christy, smoke-abatement engineer, Hudson County, N. J.; Andrew W. Jones, smoke inspector, Atlanta, Ga.; Gordon D. Rowe, Chief smoke inspector, Cincinnati, O.; J. F. Barkley, Washington, D. C., supervising engineer, fuel economy service, U. S. Bureau of Mines; and Frank A. Chambers, secretary-treasurer, Smoke Prevention Association of America, and chief smoke inspector, Chicago, Ill.

existing utilities, when they may not want the extra load during this short period.

Unless other means of cooling are provided, the use of water in air conditioning plants will shortly become so tremendous that no city will be able to provide sufficient water supply. Fortunately cooling can be provided by the atmosphere. In large installations this is quite a general practice through the use of cooling towers where the saving in water cost usually offsets the cost of owning and operating the cooling tower. The speaker said that with the evaporative condenser used in many small stationary installations only 5 to 10 per cent of the water is required which would be necessary if used directly for cooling. Atmospheric condensers are saving over 1,000,800,000 gals. of water a year, or enough to supply a city of 50,000 people. Mr. Carrier estimated that at the beginning of this year there are about 511,000 hp. in connected air conditioning load in this country, that by 1937 nearly 600,000 hp. will be in service and that by 1945 about 4,000,000 hp. will be operating in this field. The probable annual power cost will then be about $80,000,000. The speaker said that the efficiency of air conditioning equipment can hardly be expected to improve more than 5 or 10%. Even this may not be worth the cost of obtaining it, as there is a definite economic balance between costs of construction and of operation. The installed cost of an individual unit to cool a medium-sized room may eventually be brought down to between $250 and $300.

SOCIETIES AND SCHOOLS

HAMPTON INSTITUTE, Hampton, Va., is planning to assemble a complete file containing catalogs of firms manufacturing or selling power, heating, plumbing, ventilating, air-conditioning and refrigerating equipment for use in connection with repairs to, improvements in, and replacements of the mechanical equipment in some 150 buildings and a power plant. This file would also be available to students in a 4-yr. course in which the above subjects are taught. Catalogs from interested companies should be addressed to Alfred Abbond, head of the Plumbing & Heating Dept., Hampton Institute, Hampton, Va.

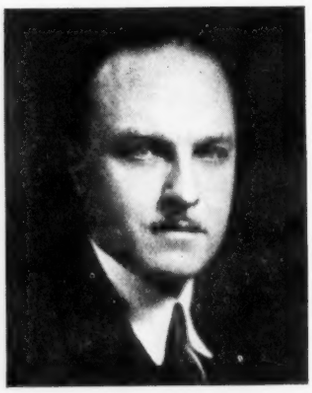
SMITHSONIAN INSTITUTION, Washington was presented Oct. 8 a bronze bust of Lord Kelvin by the English-Speaking Union of the British Empire. Lord Kelvin is known as the "father of modern refrigeration and air conditioning."

AIR CONDITIONING MANUFACTURERS' ASSN. has adopted application engineering standards for comfort air conditioning.

THE ELECTRIC WELDING SECTION of the National Electric Manufacturers Association has established development headquarters in the Frick Building, Pittsburgh, Pa., to handle a program of cooperative industry development. H. S. Card, formerly editor of the *Welding Engineer* and author of "The Welding Industry," has been appointed development director.

POLYTECHNIC INSTITUTE OF BROOKLYN, N. Y., is offering evening courses in heating, ventilating and air-conditioning during the regular 1936-1937 school season.

PERSONALS



DAVID DASSO has been elected vice-president of the Diesel Engine Division, American Locomotive Co., with headquarters at 30 Church St., New York, to succeed R. B. McColl, who has resigned to become president of Alco Products, Inc., a subsidiary of American Locomotive Co. Mr. Dasso was born in Lima, Peru in 1891, attended the school of engineering there, had a year in the department of engineering at the University of Illinois, and was graduated in mechanical engineering from M.I.T. in 1912. He was at one time manager of Vulcan Iron Works, Peru's most important machine shop and foundry, and later an agent for various lines of imports, including Sulzer diesel engines. In the fall of 1932 Mr. Dasso was appointed Sulzer representative in New York, which position he held, with the exception of one year, 1935-36, when he was managing director of Sulzer Bros. office in Buenos Aires, until his present election.

C. E. CHATFIELD has been appointed by Delta-Star Electric Co., Chicago, as Indiana sales representative, with headquarters at 503 Illinois Bldg., Indianapolis, Ind.

W. G. CHRISTY, smoke abatement engineer, Hudson County, N. J., will speak on combustion before the Industrial Smoke Abatement Association Nov. 19 at 2 p.m., in the Physics Lecture Room, Stevens Institute of Technology, Hoboken, N. J.

H. H. CLEVELAND, formerly general sales manager of Billings & Spencer Co., Hartford, Conn., has become associated with Bonney Forge & Tool Works, Allentown, Pa.

FRANK B. CONLON has become sales engineer for Sheffler-Gross Co., Inc., Drexel Bldg., Philadelphia, Pa.

R. E. ANDERSON has been appointed sales manager of Delta Star Electric Co., Chicago. He has been with the company since 1920.

LESTER M. CURTISS, superintendent of production at Lukens Steel Co., Coatesville, Pa., has been made assistant general superintendent.

BERNARD W. LYNCH has been elected president of Standard Gas & Electric Co., Chicago, to succeed John J. O'Brien, who died Aug. 7. Mr. Lynch has resigned as director and vice-president of H. M. Byllesby & Co., with which he has been associated for many years.

CAPT. H. D. LEONARD, chief engineer for Pacific Mills Co., Lyman, S. C., has been put in charge of all engineering and power work for the company, including the New England mills.

EVERETT CHAPMAN, vice-president of Lukenweld, Inc., Coatesville, Pa., has been elected president to succeed G. Donald Spackman, who has recently been promoted to general superintendent of Lukens

Steel Co., of which Lukenweld is a division. Robert J. Whiting, formerly superintendent of Lukenweld, has been elected vice-president.

HARRY C. HICKS has been appointed Chicago district sales manager by New York Belting & Packing Co. He has been with the company since 1913.

JOHN BRUCE, A.M.I.E.E., who has recently undertaken private consulting work, will have offices at Windsor House, Victoria St., London, S.W. 1, England.

ROBERT J. GRAFF, of Chicago, has been elected president of H. M. Byllesby & Co., to succeed the late John J. O'Brien. He has been first vice-president since 1924.

RICHARD HERRICK has been appointed superintendent of the Pittsfield division of the Public Service Co. of New Hampshire to succeed the late Bernard A. Lougee.

DAVID A. LOS CALZO and E. F. KUEHNLE have joined the Philadelphia office of Hagan Corporation and Hall Laboratories, Inc.

ROSS A. LANGWORTHY, formerly vice-president of Dwight P. Robinson & Co., Inc., in charge of their industrial division, has formed the Ross A. Langworthy Co., 485 Madison Ave., New York, N. Y., to specialize in engineering and construction on industrial plants and power plants.

P. S. LYON, formerly chief engineer of Cochrane Corp., has left General Electric Co. to join Turbine Equipment Co., 75 West St., Cochrane and DeLaval representative in New York, as sales engineer for Cochrane equipment.

DR. THOMAS MIDGLEY, JR., will receive the Perkin Medal of the Society of Chemical Industry for 1937, for his work in development of anti-knock fuels, safe refrigerants, etc. The medal will be presented Jan. 8.

ROGER MCWHORTER, chief engineer of the Federal Power Commission, was seriously injured in an automobile accident near Roanoke, Va., Sept. 30. He is expected to recover, but Mrs. McWhorter died Oct. 8 as a result of the accident.

H. H. STECK, formerly of Norton Co., has been appointed grinding-wheel sales representative for United States Rubber Products, Inc., in the Pittsburgh district.

R. B. NICHOLS has been appointed manager of the Industrial Bearing Division, Bantam Ball Bearing Co. He has been in the bearing industry for twelve years and was factory superintendent for Bantam in South Bend for four years, and later manager of Chicago office.

J. F. STONE has been appointed staff manager of the refrigeration section of the insulation department, Johns-Manville, 22 East 40th St., New York, N. Y.

GEORGE H. BUCHER, president and general manager of Westinghouse Electric International Co., has been elected executive

vice-president of Westinghouse Electric & Mfg. Co. with headquarters at Pittsburgh. He has been with Westinghouse since 1909.

J. H. MCELHINNEY, general superintendent of Lukens Steel Co., Coatesville, Pa., has resigned effective Sept. 24 to join another steel company He is succeeded by G. Donald Spackman, formerly president of Lukenwald, Inc., a division of Lukens. Lester M. Curtiss continues in charge of production.

W. C. STRAUB, formerly manager of the New York branch office, Chicago Pneumatic Tool Co., 6 East 44th St., New York, has been appointed assistant to the executive vice-president. A. D. Stem succeeds Mr. Straub.

CHARLES F. SCOTT, professor emeritus of electrical engineering at Yale University, has been reelected chairman of the Engineers' Council for Professional Development. H. H. Henline, national secretary, A.I.E.E., was elected secretary of the Council. R. I. Rees, assistant vice-president of A.T.&T.Co., was elected vice-chairman, and C. E. Davies, secretary, A.S.M.E., was elected assistant secretary.

PROF. ELIHU THOMSON, great American pioneer in electrical science and holder of more than 800 patents, was honored Oct. 16 when the Detroit section, American Welding Society, dedicated its program to the fiftieth anniversary of one of Professor Thomson's greatest inventions, resistance welding.

WILLIAM F. WISE has been appointed president of Republic Products Corp., 441 York St., Detroit, Mich. For nine years past he has been general sales manager of the Ex-Cell-O Aircraft & Tool Corp. R. B. Criddle has been appointed secretary-treasurer of Republic. He was formerly sales manager of the machinery division of Ex-Cell-O.

LEON H. A. WEAVER, formerly publicity manager of the Superheater Co., New York, has accepted a position in the sales and advertising department of Green Fuel Economizer Co., Inc., Beacon, N. Y.

OBITUARIES

WERNER NYGREN, president of Werner Nygren, Inc., consulting engineer of 101 Park Ave., New York, died recently. The organization will be continued under the same name by his associates, Edward Bauman, James A. Coyle and Alfred M. Nygren.

RICHARD MCCRUDDEN, 72, for many years chief engineer of the filtration plant at Belleville, Canada, died Oct. 10.

DR. SAMUEL M. KINTNER, 64, vice-president in charge of engineering, West-

inghouse Electric & Mfg. Co., died at his home in Pittsburgh Sept. 28. He had been with Westinghouse, with the exception of a short period, since 1903.

MARK V. CROKER, 67, for many years superintendent of the Newton Upper Falls, Mass., city pumping station, died suddenly Sept. 21.

NATHAN S. MILLER, a well-known figure in the steam fitting field at Fall River, Mass., died recently.

GEORGE G. E. HALL, 70, for the past 25 years an operating engineer at the plant of the Merrimac (Mass.) Light & Water Dept., and formerly chief engineer at the Boston Opera House, died at his home in Merrimac Sept. 24 after a short illness. He had been active in state politics for many years, having at one time also been a candidate for the Boston mayoralty.

ROBERT D. EDGAR, former overseer of the boiler plant in the central division of Amoskeag Mfg. Co., died in Manchester, N. H., Sept. 13. He had lived in Manchester for 60 years, was a former member of the Board of Aldermen, and had served in the State Legislature.

OWEN HUGHES, 78, chief engineer of power plants, Canadian Pacific Railroad, died Oct. 1. Born in Ireland, Mr. Hughes came to New York and joined the Edison Co., becoming chief engineer. He entered the service of the Royal Co. at Montreal in 1895, and in 1902 became chief engineer of Canadian Rubber Co. On the opening of the Angus Shops of the C.P.R. he was selected as chief engineer of power plants and shops.

ROBERT M. MCGILLIVRAY, manager of the Twin State Gas & Electric Co., Dover, N. H., died suddenly at his home there Oct. 4. He had been with the company for the past 40 years.

BUSINESS ITEMS

BABCOCK & WILCOX TUBE CO., Beaver Falls, Pa., has appointed H. S. Dershimer as Tulsa, Okla., district sales manager with offices in the Phil-Tower Bldg. Reid R. Lumsden will handle Dallas headquarters at 728 Wilson Bldg., and O. E. Berg the Houston office at 1007 Electric Bldg.

BRISTOL CO., Waterbury, Conn., has added four men to its field service organization: E. H. Hart, assigned to the Boston office, Consolidated Building; J. N. Swarr, assigned to the New York office at 220 East 42d St.; K. J. Platt, assigned to the Philadelphia office, Market St. National Bank Bldg.; and R. A. Barnes, assigned to the St. Louis office, Boatmen's Bank Building.

LINDE AIR PRODUCTS CO., a unit of Union Carbide & Carbon Corp., has opened a district office at 2 Virginia St., Charleston, W. Va., with A. R. O'Neal as district manager.

FOSTER D. SNELL, INC., Brooklyn, N. Y., has opened a Baltimore branch at 215 N. Calvert St. under direction of Theodore M. Miller.

KOPPERS GAS & COKE CO., Pittsburgh, Pa., has changed its name to Koppers Co. Three subsidiary companies have been or will be dissolved and will become divisions of the parent company, including Koppers Construction Co., which becomes the Engineering & Construction Division; Koppers Products Co., which becomes the Tar & Chemical Division, and the Bartlett Hayward Co., which becomes the Bartlett Hayward Division. Western Gas Division of Koppers Construction Co. becomes a division of Koppers Co. as does the American Hammered Piston Ring Division of Bartlett Hayward Co.

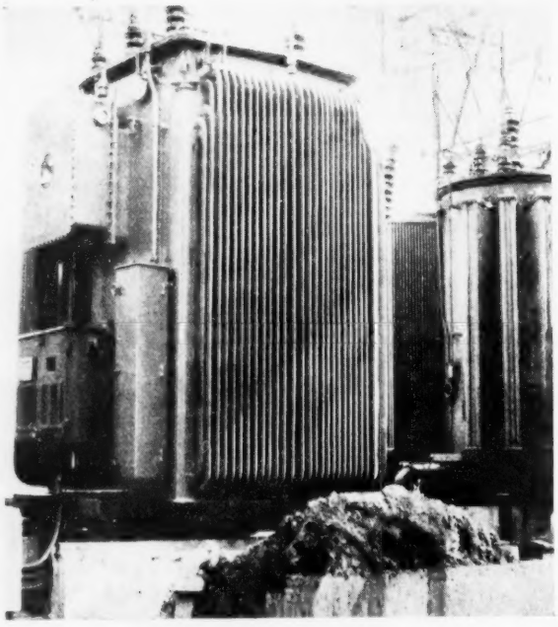
BURGESS BATTERY CO., Chicago, has purchased controlling interest in the Thordarson Electric Mfg. Co., Chicago.

HANCOCK VALVE DIVISION of the Consolidated Ashcroft Hancock Co., Bridgeport, Conn., has just released a 4-reel motion picture on the manufacture of its line of valves.

AFFILIATED ENGINEERING CORPORATIONS, LTD., OF CANADA, have been appointed sales agents for the DeWolf Furnace Corp., Rochester, N. Y., with offices in the Harbour Commission Building, Toronto, Ontario, and University Tower Building, Montreal, Quebec.

CUTLER-HAMMER, INC., Milwaukee, Wis., has opened a new switchboard plant at 970 Folsom St., San Francisco, Calif.

D. H. SKEEN & CO., 1 La Salle St., Chicago, have been appointed sales representatives for Geo. P. Reintjes Co.



SAVES $8,000

One of the largest voltage and phase angle regulators ever built has just been installed in a switching substation for a large power company to supply over 150,000 customers. This substation is tied into three generating plants by 132,000-volt high-tension lines, and a fourth plant by two 25,000-volt lines. This unit permits the small power plant, which is an old obsolete steam plant, to be shut down except when necessary. This will permit the $25,000 Westinghouse regulator to pay for itself in three years.

PATTON & BRUCE, 526 Vandeventer Ave., St. Louis, have been formed to represent boiler water conditioning and combustion control interests of Hagan Corp., of Pittsburgh, and its affiliates, Hall Laboratories, Inc., and The Buromin Co.

JEFFREY MFG. CO., Columbus, Ohio, and Snap-On Tools, Inc., Kenosha, Wis., have joined the Exhibitors Advisory Council, Inc., New York, clearing house for information on industrial, trade, business and professional shows and expositions.

EX-CELL-O AIRCRAFT & TOOL CORP., Detroit, Mich., has appointed Herberts Machinery Co., 2929 Santa Fe Ave., Los Angeles, Calif., as exclusive machinery sales representatives in southern California.

ESHELMAN & POTTER, INC., has been formed by Joseph W. Eshelman, of Birmingham, Ala., and J. T. Potter of Hall Laboratories, Pittsburgh, Pa., to specialize in power-plant equipment, involving control apparatus, water conditioning and specialties. The territory in which the new firm will work comprises Alabama, Tennessee, Georgia, Mississippi and Louisiana. They will represent Hagan in these States, as well as North and South Carolina.

LINCOLN ELECTRIC CO., Cleveland, Ohio, has moved its San Francisco office from 894 Folsom St., to 866 Folsom, containing 50% greater space.

LEEDS & NORTHRUP CO., has opened a New England office at 422 Chamber of Commerce Bldg., 80 Federal St., Boston, Mass.

KELSAN PRODUCTS has moved its plant and general offices to 1015 South Sixth St., St. Clair, Mich.

MOORLANE CO., 409-11 East Archer St., Tulsa, Okla., has been appointed sales representative for Reintjes furnace walls and arches.

PRODUCTIVE EQUIPMENT CORP., Chicago, has appointed Canadian Locomotive Co., Ltd., Kingston, Ont., to manufacture and sell "Selectro" vibrating screens in Canada and the British Colonies.

WODACK ELECTRIC TOOL CORP., 4627 West Huron St., Chicago, Ill., has arranged with Climax Rock Drill & Engineering Works, Ltd., 4 Broad St. Place, London, to manufacture its line of portable electric tools in England.

AIR & REFRIGERATION CORP., 11 West 42nd St., New York, N. Y., has opened a southern branch office in the Johnston Building, Charlotte, N. C., in charge of A. W. Bollenbeck, formerly of Ingersoll-Rand.

LAIB CO., INC., 754 South First St., Louisville, Ky., has been appointed distributor by New York Belting & Packing Co., Passaic, N. J.

STRAWS

Pointing the way business winds blow

EMPIRE TRUST BLDG., 580-586 Fifth Ave., New York, is installing its own power plant, to include two 2250-sq.ft. Keeler boilers, each delivering 14,000 lb. of saturated steam per hr. and oil-fired Peabody burners. Two Ames vertical uniflow engines driving 150-kw. Crocker-Wheeler generators and two 5-cyl., 240-hp., Ingersoll-Rand diesels also driving 150-kw. Crocker-Wheeler generators will also be installed, the four prime movers being mounted on a single foundation isolated from the building structure by sand. In general the installation is similar to that of the Ice Club, *Power*, pages 155a and b, March, 1936, except that it will have twice the capacity. The steam engines are 3-cyl., 400-r.p.m., 10½x11-in. units, the diesels 4-cycle, 11x18-in., 360-r.p.m. units. Generators are 600-amp., 250-volt, welded-frame machines. This building is also owned by the Henry Phipps estate and Harry J. Smith, supervisory engineer for the owners, designed the plant and is supervising its installation.

GOETZE GASKET & PACKING CO., INC., New Brunswick, N. J., has just completed its fourth addition since 1928.

UNITED REFINING CO., Warren, Pa., has approved plans for power house, with 230-ft. brick stack, at oil-refining plant at Struthers. In connection with expansion in refinery, entire project to cost about $250,000. H. W. Schmidt is general manager.

ATLANTIC REFINING CO., 260 South Broad St., Philadelphia, Pa., will build welded steel pipeline for gasoline transmission from Quentin, Pa., to Williamsport, Pa., about 75 miles. Branch pipelines for service at Sunbury and Williamstown, Pa.

PENNA. RYE DISTILLERIES, INC., West Bridgewater, Pa., will make extensions in steam power house, including boiler units.

COMMONWEALTH ICE & COLD STORAGE CO., 220 Northern Ave., Boston, Mass., plans 8-story cold-storage and refrigerating plant, 100x240 ft., at Fish Pier. Cost over $650,000. T. D. MacInerney, company engineer.

CABOT GAS CORP., Olean, N. Y., affiliated with Godfrey L. Cabot, Inc., Boston, Mass., has awarded contract to I. C. Little Co., Dallas, Tex., for 14-in. welded steel pipelines from Western Pennsylvania to Rochester, N. Y., about 92 miles. Line will be used for natural-gas transmission to Eastman Kodak Co., which has contracted for three years. Line will pass through Allegany, Wyoming, Monroe and Livingston Counties, where natural gas will be furnished a number of communities. Entire project will cost about $1,500,000.

BOARD OF EDUCATION, New Britain, Conn., plans boiler plant at Bartlett School, Grove St. Cost over $40,000. Central heating service. Max J. Unkelbach, New Britain, architect.

TRENTON PUBLIC OWNERSHIP LEAGUE, Trenton, N. J., John E. Kelly, president, heads project to construct and operate a municipal power plant. Proposed to secure vote at early date. Cost close to $8,000,000.

SOUTH

DELAND, FLA., has called special election Nov. 17, to approve bonds for $398,000, for municipal power plant. Financing through Federal aid.

MUNICIPAL UTILITIES, INC., Eunice, La., has plans for welded pipeline from gas field near Tepetate, La., to Eunice, about 11 miles. Cost about $80,000.

VETERANS' ADMINISTRATION, WASHINGTON, D. C., contracted Worthington Pump & Machinery Corp., Harrison, N. J., for diesel set for institution at Bay Pines, Fla., at $18,874.

BOARD OF TRUSTEES, University of Tennessee, Knoxville, has plans for addition to power house at institution. Cost about $22,000.

TREASURY DEPT., Washington, D. C., plans steam power plant at new group of laboratory buildings for Public Health Service Division at Bethesda, Md. Bids soon on general contract. $1,363,000 arranged.

CELANESE CORP. OF AMERICA, INC., Amcelle, near Cumberland, Md., plans steam-electric plant, including 10,000-kw. turbo-generator. Contract for building let to George F. Hazelwood, Cumberland. Plant will cost about $300,000. Company headquarters are at 180 Madison Ave., New York, N. Y.

KENTUCKY SPRINGS DISTILLERY CO., 429 West Market St., Louisville, Ky., plans steam power plant in connection with new multi-unit distillery at Fisherville, Ky. A storage and distributing building, capacity of 12,000 bbl., with mechanical-handling and loading equipment, will be constructed. Entire project will cost close to $100,000. Walter C. Wagner, Breslin Bldg., Louisville, architect and engineer.

WINCHESTER COLD STORAGE CO., Winchester, Va., has acquired adjoining site, 150x400 ft., for proposed addition to ice and cold storage plant, reported to cost over $50,000, with equipment.

CORBIN, KY., has authorized extensions in municipal plant. Improvements also in municipal waterworks. Fund of $100,000.

WASHINGTON, N. C., has secured $64,000 through Federal aid for extensions in municipal plant. William C. Olsen, Raleigh, N. C., consulting engineer.

SEAFORD, DEL., has approved 20-year franchise for Seaford Light & Power Co., Seaford, recently organized, affiliated with Fairbanks, Morse & Co., Chicago, Ill., to begin early next year. Company plans installation of diesel plant. Entire project will cost about $180,000.

HENDERSON, KY., plans boiler plant and pumping station for water system. Includes elevated steel tank and tower; cost about $367,000. Financing through Federal aid.

ABBEVILLE, LA., plans five pumping plants for municipal sewerage system. Fund of $180,000 being arranged through Federal aid. J. B. McCrary Engrg. Corp., 22 Marietta St., Atlanta, Ga., consulting engineer.

BOARD OF DIRECTORS, Julius Marks Tuberculosis Sanitorium, Georgetown Pike, Lexington, Ky., plans steam plant for central heating. Cost about $120,000. Financing through Federal aid. Frankel & Curtis, Lexington, architects.

OWENSBORO, KY., contracted Walter H. Wilms & Co., Union Guarantee Bldg., Detroit, Mich., for 5,000-kw. turbo-generator for municipal plant. Charles Brossman, Chamber of Commerce Bldg., Indianapolis, Ind., consulting engineer.

NAVY DEPT., Washington, D. C., has contracted Graham Mfg. Co., Inc., Jackson Bldg., Buffalo, N. Y., for a 6,000-kw. steam condenser unit for power house at Navy Yard, Norfolk, Va., at price of about $30,000.

BOARD OF TRUSTEES, CHARITY HOSPITAL, New Orleans, La., plans steam central-heating plant. Bids soon. Entire project will cost about $7,000,000. Weiss, Dreyfous & Seiferth, Maison Blanche Bldg., New Orleans, architects.

UNIVERSITY OF TENNESSEE, Knoxville, Tenn., will begin work soon on new power plant. Fund of $54,000 arranged. Ford L. Wilkinson, Knoxville, consulting engineer.

FAYETTE, MISS., has contracted Fairbanks Morse for diesel-generating unit in municipal power plant.

WILLIAMSON VENEER CO., East Baltimore & Haven Sts., Baltimore, Md., plans 1-story boiler house in new veneer mill at Cockeysville, Md. Entire plant to cost about $40,000.

SOUTHERN KRAFT CORP., one of the principal subsidiaries of International Paper Co., 220 East 42d St., New York, is breaking ground at Georgetown, S. C., for a new kraft-paper mill to be the largest in the world. It will represent an investment of over $8,000,000 and will give employment to over 2,200 men. No announcement has as yet been made regarding power facilities.

WORK on the first section of the spillway at Pickwick dam at Corinth, Miss., was begun Oct. 1. Excavations have also been begun on the north bank of the Tennessee River for the power-house foundation.

NORTHEAST MISSISSIPPI CO-OPERATIVE ASSN., Tupelo, Miss., plans 1-story cold-storage and refrigerating plant. Cost about $30,000. Financing through Federal aid.

VIRGINIA STATE CORPORATION COMMISSION has authorized the city of Danville to go ahead with its hydro-electric development at the Pinnacles of Dan. Two concrete arch dams are to be built on the Dan, one two miles downstream from the mouth of Ivy Creek, and another 8 miles farther down, a diversion dam. Included are 8,000 ft. of wood-stave pipeline, a 70-in. concrete-lined tunnel 2,300 ft. long, and a welded steel penstock 60 to 54-in. in diameter 1,200 ft. long. The power house will be on the right bank two miles below the diversion dam.

ALEXANDER CITY, ALA., plans new gas plant and distributing system. Cost about $70,000. Bids soon. R. L. Kenan & Associates, Bell Bldg., Montgomery, Ala., consulting engineers.

BUREAU OF DISTRICT COMMISSIONERS, District Bldg., Washington, D. C., will install two motor-driven pumping units at waterworks pumping station, Bryant St., replacing two steam-driven pumps. Fund of $123,000 approved.

ROBBINS KNITTING CO., High Point, N. C., plans boiler house at new textile mill at Spruce Pine, N. C. Entire project will cost close to $45,000.

VICKSBURG, MISS., plans welded steel gas-distribution pipeline, including line from field near Jackson, Miss. Cost about $335,000. Financing through municipal bond issue and Federal aid.

BUREAU OF YARDS & DOCKS, Navy Dept., Washington, D. C., plans extensions and improvements in steam power house at Naval Operating Base, Norfolk, Va., for central heating system, including new equipment. Fund of $75,000 authorized.

NATIONAL ADVISORY COMMITTEE FOR AERONAUTICS, Langley Field, Va., has secured $1,100,000 for new wind tunnel at local station, including mechanical draft Equipment, engine and other equipment.

MIDWEST

HOUSE OF DAVID, Benton Harbor, Mich., has secured site from City Commission on waterfront for new cold-storage and refrigerating plant for fruit service. It will be one and multi-story type, estimated to cost $125,000.

TRI-COUNTY PIPE LINE CO., Garden City, Kan., will build 10-in. welded steel pipeline from natural gas fields at Holcomb, Kan., to Scott City, Kan., and vicinity, about 70 miles, for gas transmission. Cost close to $500,000 with booster compressor stations and other operating facilities.

ONAWA, IOWA, contracted McIntosh & Seymour Corp., (American Locomotive Corp., Diesel Division) Auburn, N. Y., for two diesel units for municipal plant, replacing present steam engines, at $123,790. Buell & Winter Engrg. Co., Sioux City, Iowa, consulting engineer.

STATE CENTER, IOWA, plans diesel engine at municipal plant. H. M. Meads, town clerk.

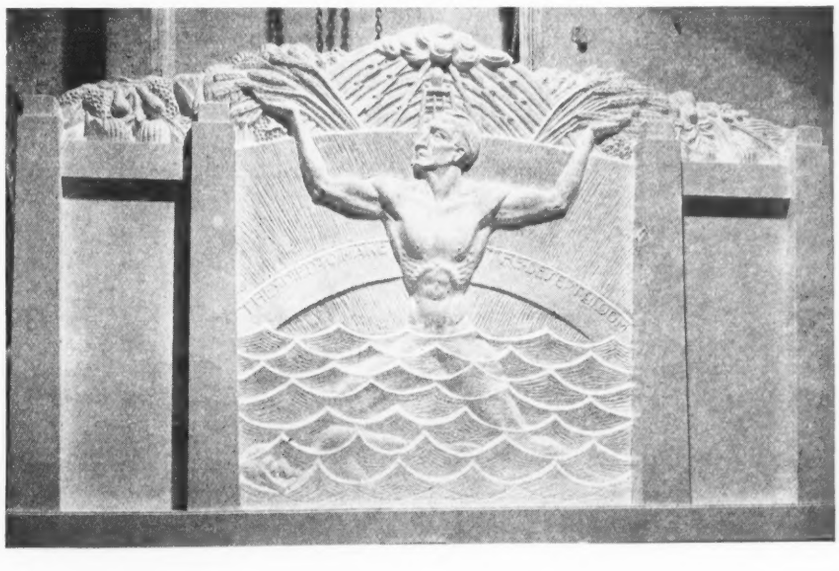
BOARD OF PUBLIC SERVICE, St. Louis, Mo., contracted Erie City Iron Works, Erie, Pa., for three cross-drum, straight-tube boiler units with accessories for boiler plant at new service building for City Hospital No. 1, Dillon & Carroll Sts., at $53,670.

IOWA CITY LIGHT & POWER CO., Iowa City, Iowa, plans steel pipeline for natural-gas distribution. Cost about $55,000, including distributing station and control plant. Roscoe E. Taylor, general manager.

SOUTH CHARLESTON, OHIO, has plans for municipal plant to cost $80,000. Bond issue before voters Nov. 3.

TO MAKE THE DESERT BLOOM

This memorial tablet will be placed at Boulder Dam in memory of workmen who died in its construction. It goes on the Arizona side of Black Canyon and is 11 ft. 3 in. wide. The inscription on the face says "They died to make the desert bloom"



PORTLAND, IND., has contracted General Electric for turbo-generator for municipal station, at $72,160; to Worthington Pump & Machinery Corp., Harrison, N. J., for pumping machinery and accessories, at $30,040; and to Allis-Chalmers Mfg. Co., Milwaukee, Wis., for switchboard and auxiliary equipment, at $27,200. General erection contract has been let to Yost Bros., Decatur, Ind., at $33,615.80. Financing has been arranged through Federal aid.

WELLINGTON, KAN., has contracted Cortelyou Construction Co., 1717 East Second St., Wichita, Kan., for addition to municipal power plant. New equipment will be installed, including a 2,000-kw. turbo-generator unit and accessories. Cost about $127,100. Black & Veatch, 4706 Broadway, Kansas City, Mo., consulting engineers.

PAPER MAKERS CHEMICAL CORP., Kalamazoo, Mich., will build a steam power house, 36x38 ft., at Elroy, Wis., on which work will proceed at early date. Entire project will cost about $100,000. Donald Whalen, engineer.

LAND O'LAKES CREAMERIES, INC., 2201 N. E. Kennedy St., Minneapolis, Minn., plans steam power house at milk-processing plant at Luck, Wis., where site is being acquired. Entire plant will cost about $125,000.

WISCONSIN ICE & COAL CO., 1518 East North Ave., Milwaukee, Wis., plans 1-story L-shaped ice-manufacturing plant at South 43rd & West Orchard Sts., 28x97 ft. and 43x66 ft. Cost over $75,000, with equipment. G. H. Kopmeier, vice-president, in charge.

GLADSTONE, MICH., has plans for new municipal plant. Bond issue of $100,000 being arranged. Shoecraft, Drury & McNamee, Ann Arbor, Mich., consulting engineers.

CEDARBURG, WIS., has contracted Nordberg Mfg. Co. for 750-kw. diesel for municipal plant.

STATE BOARD OF CONTROL, Des Moines, Ia., has contracted Murray Iron Works, Burlington, Ia., for one 15,000-sq.ft. watertube boiler for power house at Cherokee (Ia.) State Hospital. Chain-grate stoker to Illinois Stoker Co., Alton, Ill., and for stack to Consolidated Chimney Co., Chicago, Ill.

ANOKA, MINN., has authorized surveys of proposed municipal hydro plant at Pillsbury Dam, including standby diesel-generating station. Burlingame & Hitchcock, Sexton Bldg., Minneapolis, Minn., consulting engineers.

JOSEPH SCHLITZ BREWING CO., West Galena St., Milwaukee, Wis., is considering enlargement of power plant on West Cherry St. Cost over $75,000.

OWENS-ILLINOIS GLASS CO., Toledo, Ohio, has plans for steam power house at glass container-manufacturing plant at Gas City, Ind. Work will begin in October. Cost over $40,000.

HARBOR BEACH, MICH., will make improvements in waterworks, including installation of electrical equipment and new main pipeline for intake. Fund of $25,000 authorized.

NEWTON FALLS, OHIO, is asking bids for installation of complete diesel generating plant including building, switchboard, and electrical distribution system. Copies of plans and specifications may be obtained upon application to Bryan & Sigmon, consulting engineers of Newton Falls, Ohio, Box 111.

COFFEYVILLE, KAN., plans extensions in power plant, including 5,000-kw. turbo-generator and auxiliaries. Cost about $200,000. Financing through Federal aid.

BEREA, OHIO, soon begins a survey and report for extensions and improvements in municipal plant. William C. Kammerer & Associates, Smythe Bldg., Cleveland, Ohio, consulting engineers.

DEARBORN CHEMICAL CO., Chicago, is completing an extension to its main manufacturing plant to give 16% increase in floor space. Offices were also remodeled and air conditioned.

FEDERAL POWER COMMISSION has established a regional office in Denver, Colo., with Lesher S. Wing as regional director. Offices are in the Central Savings Bank Bldg., 15th & Arapahoe Sts. This is the fourth regional office. The fifth and last, to be located in Chicago, will be opened on or before Dec. 1.

EDWARDSVILLE, ILL., plans municipal plant and distributing system. Special election to vote bonds for $216,000. Entire project will cost about $390,000, remainder through Federal aid.

A. H. WEINBRENNER CO., 226 East Juneau Ave., Milwaukee, Wis., plans steam power house at new shoe-manufacturing plant at Antigo, Wis., where building will be erected by Antigo Industrial Foundation, Inc., and occupied by first-noted company under long-term lease. Cost close to $100,000. Herman J. Esser, 4232 North Lake Dr., Milwaukee, advisory architect.

SPENCER, IA., plans addition to municipal power plant, to include a 1500-kw. generator unit and auxiliary equipment. Young & Stanley, Muscatine, Iowa, consulting engineers.

MICHIGAN-TOLEDO PIPE LINE CO., Mount Pleasant, Mich., plans new 6-in. welded steel pipeline for crude-oil transmission from Greendale Township, Midland County, Mich., to Mount Pleasant, about 12 miles, where connection will be made with main pipeline system to Toledo, Ohio. Cost over $100,000 with booster pumping stations.

ALTA, IA., has contracted Electrical Engrg. & Construction Co., Des Moines, for addition to municipal plant, including 450-hp., diesel, changing present generator to a.c., switchboard and auxiliary equipment. Cost about $75,000. Buell & Winter Engrg. Co., Sioux City, Ia., consulting engineer.

REPUBLIC BRONZE POWDER CO., 3000 Woodhill Rd., Cleveland, Ohio, plans steam power house at proposed new plant on Forbes Road, Bedford, Ohio. Plant will comprise five buildings, estimated to cost over $60,000. Affiliated with Sheffield Bronze Powder Co., same address. Edward Hoefler, 5005 Euclid Ave., Cleveland, consulting engineer.

NORWALK, OHIO, plans extensions in municipal power plant, including turbo-generator and accessories. Bids soon. Cost about $100,000. Granville E. Scott, Norwalk, consulting engineer.

AITKIN, MINN., plans installation of new diesel set at municipal plant, authorized at special election.

ST. MARY'S OF THE LAKE SEMINARY, Mundelein, Ill., plans extensions in steam power plant in conjunction with new laundry, entire project to cost about $55,000. McCarthy, Smith & Eppig, 43 East Ohio St., Chicago, Ill., architects.

COHODAS BROTHERS CO., Ishpeming, Mich., plans early construction of 1-story and basement cold-storage plant at Oshkosh, Wis. Cost close to $45,000. D. E. Anderson, Marquette, Mich., architect.

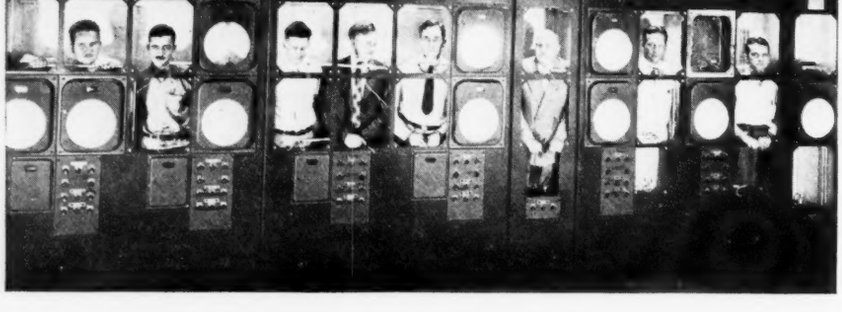
STANOLIND PIPE LINE CO. has awarded Williams Bros. Construction Co. contract for a Lindewelded 10-mile 6-in. oil line at Russell, Kan. Pipe will be reconditioned from a 20-mile 6-in. line near Eldorado, Kan.

BURROUGHS ADDING MACHINE CO., Detroit, Mich., plans steam plant for central heating at new multi-unit plant near Plymouth, Mich. Entire project will cost over $200,000. Albert Kahn, Inc., New Center Bldg., Detroit, is architect and engineer.

NEW LISBON, WIS., contracted Fairbanks, Morse & Co., Chicago, Ill., for 300-hp. diesel unit. J. W. Grulke is superintendent of water and light plant.

HUMAN METERS

Industrial plant management is rapidly coming to realize that automatic control and meters in the hands of intelligent operators pay big dividends. Here is an example, a meter borrowed for a large New England industrial plant, which is modernizing its boiler plant and equipping for oil burning. This boiler panel, being built by the Hays Corp., will contain automatic control and metering equipment to operate the boilers at maximum efficiency continuously. Looking through the space for meters and control equipment are: from left to right, Hans B. Freeman, F. D. Burns, Edmund D. Kennedy, Hans O. Linde, Wm. H. Pugsley, Phil T. Sprague, (president), Shirl M. Rudolph, and John R. Heming, all of the Hays Corporation



STATE BUILDING COMMISSION, Jefferson City, Mo., has following low bids for equipment for power house at local state penitentiary. Westinghouse Electric & Mfg. Co., East Pittsburgh, Pa., turbo-generator, $97,670.18, condenser, $30,273, and switchboard, $21,785; Sewell Well Co., St. Louis, Mo., pumping machinery and well, $11,471; Chicago Bridge & Iron Works, Chicago, Ill., elevated steel tank and tower, $38,200. Charles A. Haskins, Finance Bldg., Kansas City, Mo., supervising engineer.

GUIDE LAMP CORP., 1637 West Twenty-fifth St., Anderson, Ind., has plans for 1-story steam power house, 50x60 ft., and will construct soon. F. L. Burke, president and general manager.

GRAFTON, N. D., has contracted Fairbanks Morse for new 875-hp. diesel-generator and auxiliary equipment for municipal power plant, at $59,010. L. R. Roney, supt., Water & Light Department, in charge.

ENAMEL PRODUCTS CO., Eddy & Taft Sts., Cleveland, Ohio, has filed plans for 1-story boiler house. General contract to Austin Co., Cleveland. Cost about $30,000. J. C. Rumbarger, chief engineer, in charge.

ELKHART, IND., is considering a municipal power plant, to be constructed on site adjoining waterworks. Surveys soon.

EAST MOLINE, ILL., plans extension in water pumping station. Cost about $25,000.

CHICAGO RAWHIDE MFG. CO., 1301 Elston Ave., Chicago, Ill., has plans for a boiler house, 31x46 ft., and will begin work soon. Axel V. Tiesen, 5302 North Spaulding Ave., architect.

DOVER, OHIO, contracted George H. Whike Co., Harter Bank Bldg., Canton, Ohio, for extensions and improvements in municipal plant. Cost about $124,000.

JUDSON RUBBER WORKS, 4107 West Kinzie St., Chicago, Ill., has plans for 1-story addition to boiler plant at factory, 25x30 ft., and will begin work soon. Edward H. Nordlie, 4825 North California Ave., is architect.

NORWALK, OHIO, is planning installation of a 2,500-kw. turbo-generator and auxiliaries in its municipal plant. Estimated cost, $100,000. William C. Kammerer & Associates, Smythe Bldg., Cleveland, Ohio., consulting engineers.

MERCHANTS DISTILLING CO., Terre Haute, Ind., plans power house with three 1,500-sq.ft. boiler units, pumps and accessory equipment. Entire expansion project to cost over $250,000.

SOUTHWEST

DUNCAN COFFEE CO., 1221 Gavilan St., Corpus Christi, Tex., plans boiler house. Entire project (including packing plant) will cost about $100,000. N. W. Hardy, Nixon, Bldg., Corpus Christi, architect.

UNION POTASH & CHEMICAL CO., Avalon, N. M., plans power house at new potash mill and refining plant at properties about 20 miles from Avalon. Entire project will cost over $85,000.

AMERICAN LIBERTY PIPE LINE CO., First National Bank Bldg., Dallas, Tex., plans 6-in. welded steel pipeline from Sulphur Bluff oil field, Hopkins County, Tex., and Talco oil field, to main pipeline to site of proposed oil refining plant in Eastern Texas district, about 70 miles, for crude-oil transmission. Cost about $450,000, with booster pumping stations and other operating facilities. Refinery will be constructed by American Liberty Oil Co., same address, and will include steam power house, pumping station and bulk tank plant. Latter project will cost about $500,000.

HALON-BUCHANAN, INC., Tulsa, Okla., oil operator, plans steam power house at new gasoline blending plant at Corpus Christi, Tex., Entire project will cost about $100,000.

GULF PRODUCTION CO., Fort Worth, Tex., will build new welded steel pipeline from oil fields at Humphreys and Tipton, Okla., to bulk oil terminal at Burkburnett, Tex., about 55 miles, of which about 20 miles will be 6-in. pipe, and remainder 4-in. pipe. Pumping stations along route. Cost over $400,000. Company is a subsidiary of Gulf Oil Corp., Fort Worth.

TEXAS WOOL SCOURING CORP., San Angelo National Bank Bldg., San Angelo, Tex., Abraham Meyer, president, plans steam power house. Entire project (with scouring plant) will cost over $100,000.

CRUDE OIL PIPE LINE CO., Corpus Christi, Tex., plans welded steel pipeline from Driscoll oil-field to Corpus Christi, about 25 miles. Cost over $150,000.

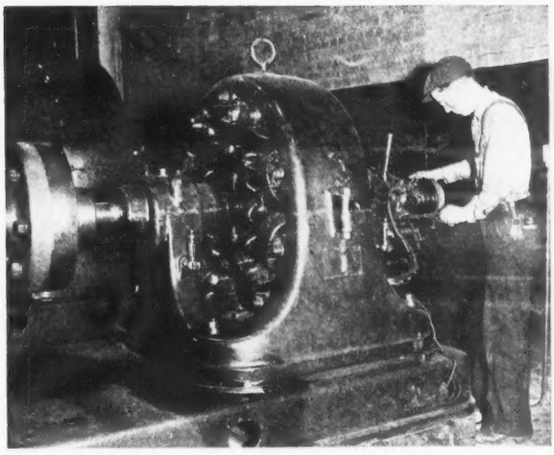
BOULDER DAM sent power to Los Angeles for the first time Oct. 7 when the first of the 115,000-hp. generators went into service. First power generation at the dam occurred Sept. 11, but only a small 3,500-hp. generator was put into service at that time, generating current for use at the dam and in Boulder City. Ultimately there will be fifteen 115,000-hp. units, of which four are now being installed.

OKLAHOMA NATURAL GAS CO. has awarded E. M. Campbell Co., Tulsa, Okla., a contract for construction of a 10-mile 6-in. Lindewelded gas line near Cement, Okla.

LEFLORE COUNTY GAS CO., Poteau, Okla., will build a 25-mile 8-in. Lindewelded gas line from Red Oak, Okla., to a point ten miles northeast of Poteau.

EMPIRE COMPANIES, Bartlesville, Okla., have awarded J. F. Pritchard Co., Kansas City, contract for 14 mi. of 4-in. Lindewelded gasoline pipeline from their new refinery to Odessa, Tex. Also two gathering lines, one 4 mi. of 5½-in. pipe, the other 4 mi. of 16-in.

FIRST A.C. POLYPHASE



Believed to be the first a. c. polyphase generator ever installed in a steel mill, this unit was installed in Edgar Thomson Works about 1895, to power Tesla induction motors and to light several of the company houses, including Charles M. Schwab's. About 1905 this Westinghouse generator was moved to the new power house and the steam-engine drive was replaced by a direct-connected motor. In 40 years, field coils have been changed only a few times and the armature has been rewound three times. It was completely submerged in the 1936 spring floods but was put back in service after drying out and replacing of a few field coils.

EL PASO NATURAL GAS CO. is Lindewelding an 83-mi. natural-gas pipeline from Casa Grande, Ariz., to Ajo, to operate at 400 lb. Outside diameter will be 8⅝-in.

BUREAU OF RECLAMATION, Denver, Colo., has contracted Allis-Chalmers Mfg. Co., Milwaukee, Wis., for two 13,000-kva., 0.80-p.f. generators and accessories at $192,223, and awarded the Pelton Water Wheel Co., San Francisco, Calif., a contract for two 15,000-hp., hydraulic turbines and governors at price of $119,779 for Casper-Alcova hydro-electric generating station, on the North Platte River, Wyo.

SODA SPRINGS, IDAHO, has approved plans for a municipal plant and will begin construction. Cost about $40,000.

OKLAHOMA CITY, OKLA., plans installation of two main electric pumping units, capacities of 15 and 16,000,000-gal. per day, and number of smaller pumps for booster and accessory service for expansion in municipal water plant. Entire project will cost about $170,500. Financing through Federal aid. T. G. Banks, engineer and water superintendent.

OWL CREEK IRRIGATION DISTRICT, Cheyenne, Wyo., plans pumping plant to cost about $43,600, for use in irrigation system. Fund through Federal aid.

FEATHER RIVER DISTILLERIES, INC., Marysville, Cal., recently organized, care of Houston, Houston & Houston, 1007 Seventh St., Sacramento, Calif., plans steam plant in connection with distillery at Marysville. Entire project wil cost over $100,000. W. H. Bryant, general manager.

BUREAU OF RECLAMATION, Denver, Colo., has secured $6,000,000 for Friant reservoir and irrigation system in San Joaquin basin, Central Valley Project, Calif., including electric-operated pumping plants.

DIABLO POWER DEVELOPMENT of the City of Seattle went into action Sept. 23 when President Roosevelt pressed the button that started the 95,000-hp. generator. This eliminates the necessity of operating the Lake Union steam plant and of buying power from Tacoma. Within another few months the second unit will add another 95,000 hp. Work is expected to start soon on construction of Ruby Dam, 6½ miles above Diablo, which will be 100 ft. high, of concrete, and impound 130,000-acre-ft. of water. PWA has just granted $3,000,000 for construction of Ruby Dam and of the power transmission line. The remaining $5,000,000 will be city bonds.

WHAT PRICE VANITY?...

Kentucky has its colonels, Tennessee its admirals, and now Florida its engineers. Kentucky, recognizing that Col. Shirley Temple, for example, cannot command troops in battle, also permits army colonels within its borders. Tennessee likewise admits and honors real admirals. But Florida has just forbidden the National Association of Power Engineers from using the last part of its name in that state, on the grounds that the designation "engineer" belongs only to those professional men who have passed a state examination. The whole thing is reminiscent of the state whose legislators once solemnly decided to make π an even 3 for convenience in figuring.

I have no quarrel with laws which try to evaluate men for professional responsibility, so long as they limit themselves to that. But why are there not laws which forbid the designation "doctor" to all but M.D.'s, eliminating the doctors of philosophy, laws, science and engineering? They would be as logical. Is any licensing board empowered to take the name of a group that has existed for more than fifty years and of a profession that has existed since steam engines were invented and restrict it to another and younger group? Can it, by so doing, legislate that older group out of its place in the sun?

The Bible says, "By their works ye shall know them." No mortal person can set up an aristocracy of the privileged and label it by any title and expect it to be revered. It must justify that title by its works.

I hold no quarrel with professional engineers. Their work is extremely valuable, and in the power field alone has been responsible for much of the advancement. But they certainly have not been responsible for it all. Right here in the United States we have more power than any place else in the world. It has not been developed by professional engineers alone; why should it be administered by them alone?

The professional engineer deserves credit for his contribution, but so does the operating engineer. They can work together towards tremendous accomplishments. Are they instead to waste their time in useless bickering over a title? Once, when I was 18, I was "Supervisor of Small Tools" in a machine shop—at 20 cents an hour. The title certainly was high-sounding, and impressed ignorant people tremendously, but most of my friends, unblessed by title, made more than I did. I'd have been better off as "tool-crib kid" at a bigger wage. Sometimes all these letters fore and aft of someone's name remind me of that story.

Undoubtedly, some of the desire of the professional engineer to create a profession by legislation is to get rid of the "beauty engineers," "mortuary engineers" and so on who try to lend dignity to commonplace professions by giving them fancy titles. That part is commendable. But isn't most of the desire fundamentally based on just plain vanity? It seems so to me. And that belief is borne out by the fact that many engineers I know refuse to have anything to do with the movement, consider the whole thing a parasitical growth on a program originally intended to help civil engineers alone. In many states, the laws were slipped through so quietly that many engineers did not realize what was happening. Either intentionally or unintentionally, no opportunity was given for proper discussion. The result is inevitable—we have laws which are running away with their original proponents, laws which are beginning to indicate that somebody has bitten off more than he can chew.

George Edwards

GEORGE EDWARDS
Engineer

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Volume 80 Number 12

POWER

MASON BRITTON, *Senior Vice-president* · PHILLIP SWAIN, *Editor* · N. O. WYNKOOP, *Manager*

Associate Editors—F. A. ANNETT, R. B. PURDY, E. J. TANGERMAN

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PAUL WOOTON

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McGRAW-HILL PUBLISHING COMPANY, INC.

Publication Office, 99-129 North Broadway, Albany, N. Y.
Editorial and Executive Offices: 330 West 42nd St., New York, N. Y.

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MASON BRITTON, Senior Vice-President
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LONDON, Aldwych House, Aldwych. London. W.C.2

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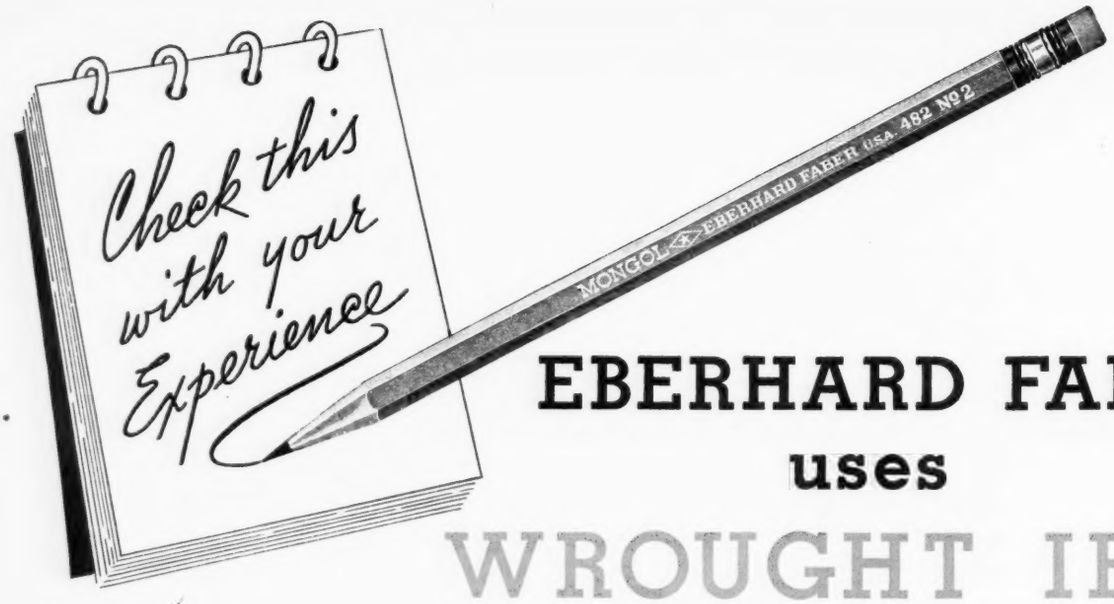
POWER articles are currently indexed in both the Industrial Arts and the Engineering Indexes, available at public libraries. Also every year POWER issues an annual index of its own. Cable Address: "McGraw-Hill, N. Y."



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